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December 29, 1921

Engineering News-Record

Devoted to Civil Engineering and Contracting
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Raising a Sunken Dredge in the Port of Portland, Ore.

Initial Results from Road Test at Pittsburg, Cal.

Utilizing Gas from Sewage Sludge

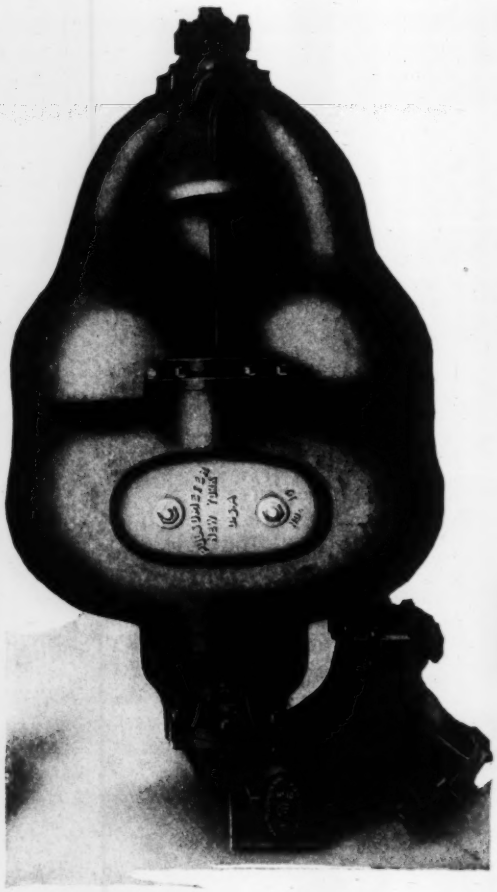
Two Recent Cases of Water-Rights Litigation

The Probable Frequency of Intense Rainfall

Measuring Movement in the Concrete Test Road Slab at Pittsburg, Cal.

A New Year Resolution

Sizes of Pipes, Inches				CAPACITIES IN GALLONS PER MINUTE	Horse Power Boiler	AND NOTE
No.	Steam	Suction	Discharge			Weight Pounds
2	1	1½	1½	25	4	95
3	¾	2	2	70	5	140
4	1	2½	2½	125	6	295
5	1	3	3	200	9	430
6	1¼	3½	3½	350	12	570
7	1¼	4	4	450	15	745
8	1	5	5	750	25	1,375
9	1½	7	6	1,100	35	2,100
10	2	8	8	2,200	70	3,800



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 87 — NEW YORK, DECEMBER 29, 1921 — Number 26

What Is a Million Dollars?

IT IS EASY to read figures, even when a dollar sign is placed in front of them, without knowing quite what they mean. Take the case of bonds: this or that municipality sells without difficulty—say, as in the case of New York recently, $55,000,000 worth. What *is* $55,000,000? Perhaps your salary is $5,000 a year. Then, New York has gone in debt to the further amount of 11,000 years of your salary. But what is a mere 11,000 years! Public bond sales in 1921 exceeded one billion dollars—200,000 years of your financial life at $5,000. On the other hand, 20,000 men on this salary could pay off these bonds in ten years, if the cost of living were zero. The point is, millions of public dollars are worth watching when they are considered in terms of labor.

A Census in 1925

HEARTY support should be given to Secretary Hoover's advocacy of a national census in 1925. While perhaps the plan will receive most widespread approval by those who are dissatisfied with the 1920 count because its results were based on a temporary and abnormal distribution of population, there are other strong arguments for a census not only in 1925 but also midway between each decennial census. A country with more than a hundred million people, with hundreds of rapidly growing cities and thousands of industrial and political interests depending largely upon reasonably exact knowledge of population change should no longer rest content with a decennial census. Population estimates carried through a period of ten years are necessarily uncertain and likely to mislead where vital interests are concerned. For the present, at least, the census in the years ending in five might well be restricted to population, and that schedule be simplified and limited to a mere count of persons, ages, sex and perhaps nationalities. With our permanent Census Bureau this should be an easy and short task and the results could be announced in detail much sooner than is done under the more elaborate decennial plan. The resulting benefits would be many and large, especially to engineers.

The Pittsburg Road Tests

INTEREST in the tests to destruction of the reinforced-concrete road, in the form of an elliptical track, construction of which was completed recently at Pittsburg, Cal., has centered, up to the present, upon the methods employed in building the roadway and the unusually elaborate equipment installed to determine the effects of motor truck traffic, temperature and moisture. A new phase of this research work has been reached with the publication, in this week's issue, of certain preliminary observations made since traffic started its procession around the track on Nov. 9. In other words the work has passed through the planning and construction stages into that of operation. It is still too early, of course, for the real story of what the results show. Nevertheless the indications thus far made are well worth studying, for a number of significant facts were disclosed by the measuring and recording apparatus before traffic began. The California engineers have already learned some interesting things regarding the influence of temperature changes and Pittsburg has become the objective of scores of highway engineers interested in research work. In no sense are the results which will be based on the data now being collected to be considered as merely of local significance. Lessons from the Pittsburg tests will surely have a decided bearing on the future design of concrete roads, particularly with regard to reinforcement and subgrade problems.

Litigation Yields to Irrigation

RUINOUS is none too strong a word to apply to the differences over water rights that have caused so much conflict and thwarted so much development of irrigation and water power in Western North America. It it is therefore with great pleasure that we record in two articles elsewhere in this issue (1) a working agreement as to the use of water and a postponement of all litigation in the Kings River Valley, California, and (2) an order of the International Commission interpreting the St. Mary and Milk River article in the treaty between the United States and Great Britain regarding the Canadian-United States boundary waters. In the Kings River case it was a committee of engineers that effected a temporary agreement which it is hoped will open the way to provide ample water for 400,000 acres in the Kings River valley in addition to the 800,000 already fairly supplied, and thus end thirty years of hampering litigation. The St. Mary and Milk River order is of greater import, in itself and because of its international aspect, and its promise of continued amity not only with our northern neighbor but with Great Britain as well. This international order gives permanency to the temporary working basis previously worked out and administered by engineers of the United States and Canadian reclamation and irrigation services. In both the California and the international agreements engineers and common sense have been able to overcome the barriers that the lawyers have been unable to surmount, if indeed these barriers were not largely of their own creation.

Vision———Achievement

ANOTHER milestone in the progress of engineering was marked when President Harding's Armistice Day address over the bier of America's Unknown Soldier at the Arlington National Cemetery was heard not alone by the vast throng there gathered but also by other large assemblies in New York and San Francisco. This was made possible by the electrical amplifier and the loud-speaking device which have been perfected by telephone engineers after long and patient endeavor.

These men of vision and achievement look forward to the time when President's messages may be heard wherever the telephone reaches. Thus may a great nation be thrilled as one man, for, quick as is the daily press to spread the President's message abroad, the telephone is instantaneous and has all the many advantages of the spoken over the written or printed word. Next we may expect a simultaneous means of transmitting photographic images, so that posture, gesture and facial expression may be conveyed to the eye at the same time as words and voice inflections. Add to this a similar transmission of color as well as form and motion and how marvelous would be the whole! To do all three seems less marvelous now than would telegraphy a hundred, telephony fifty, or airplane flight twenty years ago. With each new engineering achievement one feels like changing the well known "wonders will never cease" to "when will wonders cease?" But the engineer knows that each marvel in his field only opens new and more splendid visions. It is for him not only to see the vision but to bridge the gap between vision and achievement.

Engineering Traffic Control

IN RECOMMENDING the rerouting of numerous street railway lines in New York City last week, Daniel L. Turner, consulting engineer of the New York Transit Commission, took a very definite step forward in the engineering control of our cities. To reroute car lines in order to better rapid transit conditions is not unique, though it is uncommon to have the recommendations come from other than the companies themselves. To clear certain streets of trolleys so that through motor routes will be provided is, on the other hand, a decidedly novel procedure. It is becoming increasingly apparent that the big municipal engineering problem of the next decade is traffic control. As *Engineering News-Record* has often pointed out, it has, in our larger cities, passed beyond the province of the police, who can only exercise an arbitrary and human control, and has become a matter of street opening and clearing and of physical arrangement of the city so that traffic takes certain routes because they prove the most economical and convenient, and not because a policeman directs it there. Mr. Turner's scheme is intended to do just this, and is important because it recognizes the fundamental engineering nature of street-traffic distribution.

Rerouting Street Cars

MR. TURNER'S suggestions are interesting for more than their specific solution of a problem in the metropolis. New York is not the only city where car tracks are on streets where they should not be today. Most of our city car lines are on routes determined in the early days of rapid transit, when every merchant wanted a street car by his door and when street traffic was hardly any problem at all. Conditions today may demand an entirely different system of routing, but franchise rights and the expense of moving act jointly to prevent any radical rerouting. In consequence, street car changes in most of our cities consist mainly in adding new routes and but rarely in a better distribution of the traffic lanes and removal of the traffic impediments fixed by car tracks. Just now few cities are provided with the legal machinery for revamping transit conditions that exist in New York, but the time is fast coming when all will have to be and when it does the city's engineers will have the responsibility of doing the work. Study of methods and results is therefore incumbent on the profession.

Too Many Automobile Killings

WHAT traffic control means in preservation of life is strikingly indicated by the comparative mortality from typhoid and automobiles, noted on p. 1074. More people are killed by automobiles than by typhoid in the registration area, where presumably both water-supply protection and traffic control are more rigid than in the remainder of the country. It was not so long ago the big city typhoid rate was above 20 per 100,000. Millions have been spent in water-purification and sanitation to bring this figure down. And yet nearly half as many people are being killed today by automobiles, with the probabilities that in our cities the automobile killings are much higher. It will pay to spend some money to save life.

Pressure for Economic Conference

WE HAVE urged in these columns that following the Disarmament and Far Eastern Conference there was needed an international meeting to adjust the world's economic difficulties. To our mind, land disarmament is a necessary precedent to satisfactory financial adjustment, but as to land disarmament, there is little continuous pressure, unless it is from the internal financial burden of those European countries which are supporting large armies. However, there is considerable momentum to the demand that there be an international economic conference. Just before adjournment, Senator France introduced a resolution authorizing and directing the President to call such a conference, the participants to include all recognized nations, with their colonies. In addition there are strong forces in both the American and European press advocating such a meeting.

It seems inevitable that these demands will result in such a conference, provided that on final adjournment the conference now under way in Washington will have proved a distinct success. With that example before it an economic conference might be able to make considerable headway in working out a solution for the present knotty international economic problems.

Open-Price Association Decision

NOTE was made in these columns last week that the U. S. Supreme Court had handed down its decision in the Hardwood Manufacturers' case—a decision long awaited with interest, because it involved the legitimacy of the "open-price" form of trade association. The decision is an affirmation of that of the lower court and, accordingly, enjoins the American Hardwood Manufacturers Association from distributing stock, production and sales reports, prohibits the discussion of prices at meetings and the giving of advice as to future production and prices. The court holds the association to be a combination in restraint of trade within the meaning of the Sherman (Anti-Trust) law. The court divided on the case six to three.

It might be inferred from the full confirmation of the lower court's decree that the decision may be taken as final on all the activities of open-price associations. From our reading of the opinion, however, we do not take that to be the case. We judge it to be final as to

one activity only—advising on future action. On other activities, as we see it, the subject still calls for the broad consideration of the court.

In the usual form of open-price associations the activities extend only to the exchange of information regarding production, stocks and shipments, and, as to prices, to current lists and figures on closed transactions. No attempt is made to estimate future price trends or to suggest the effect of future production on prices. But just this the Hardwood Manufacturers did do, and it is this that distinguishes their practice from that of other open-price associations. Around this point the whole opinion of the court is made to revolve. The argument is on the evidence that the association repeatedly suggested that curtailment of production would result in higher prices. Higher prices did follow, and the court connected the rise with the advisory work of the association.

With the whole opinion swinging on this feature of the case, then, we do not believe that the decision can be held as final on purely statistical activities. Obviously, though, the conduct of these activities *in combination* with suggestion as to future functioning is now under the ban of the law.

The decision has all the more interest because on Nov. 1 the U. S. District Court of the Northern District of Illinois held that the dissemination of data on prices, sales, stocks, etc., by the linseed-oil crushers did not contravene the law. This case will undoubtedly reach the Supreme Court and thus occasion a ruling on an association which limits its activities to the exchange of data on facts and closed transactions.

* * *

Among business men the decision in the Hardwood Manufacturers' case was not unexpected. There was a feeling that the advisory work of the association was "a step too far." On the other hand, the feeling is strong that the reporting of past transactions is within the law and will be so held by the courts—a view thus far confirmed in the linseed-oil case. In the latter view, also, this journal has concurred, as the readers will recall.

While, however, we have inclined to the belief that the exchange of information upon closed transactions would be lawful, we have not held that, as practiced, the exchange is good policy. In fact, we believe it would be better for business if full publicity were given to the figures collected by open-price and trade associations. To send them to the Department of Justice and to the Federal Trade Commission avails nothing for the purpose we have in mind; it does not take the public into the industry's confidence, and the public, kept in ignorance of the association's functioning but keenly realizing its potential power, becomes suspicious.

We cannot agree with the view expressed in the linseed-oil argument that the exchange of information between association members is on a par with the activities of open exchanges, such as the Cotton Exchange, the Chicago Board of Trade, etc. It distinctly is not. The very essence of the confidence enjoyed by exchanges is their full publicity. The transactions and prices are open to everyone, are published daily in the public prints. Would the New York Stock Exchange be able to survive public suspicion if its operations were held secret to its members; would the Chicago Live Stock Market be able to survive?

This matter of publicity is emphasized by the opinion on the hardwood case. In the next to last paragraph we find these words:

"In the presence of this record it is futile to argue that the purpose of the 'Plan' was simply to furnish those engaged in this industry, with widely scattered units, the equivalent of such information as is contained in the newspaper and Government publications with respect to the market for commodities sold on boards of trade or stock exchanges. One distinguishing and sufficient difference is that the published reports go to both seller and buyer, but these reports go to the seller only."

In this view, we believe, there is hearty public concurrence.

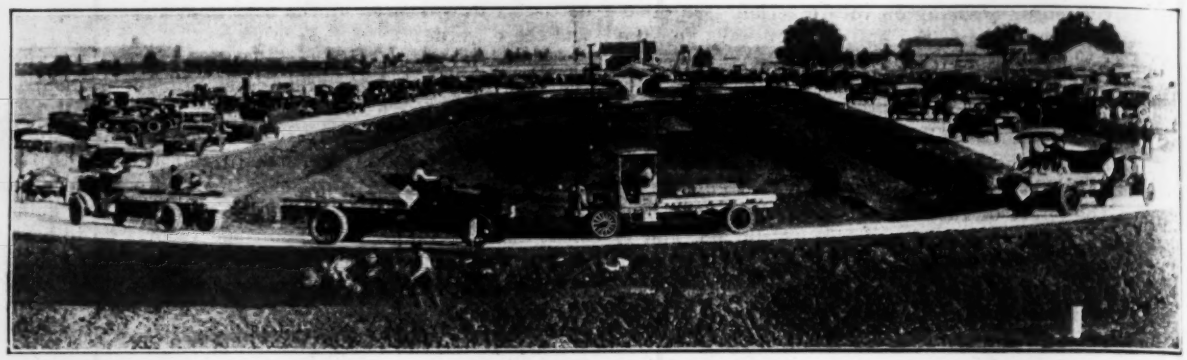
Moreover, even if the present method of exchange of price information should be found lawful, we are not convinced that it will always, or even for long, remain so. The public is firm in its determination to protect the records of individual businesses but it has not the same feeling toward associations, particularly toward those that are known to deal with prices. The war increases were, in part, responsible for this; but the suspicion and condemnation have become more serious on account of disclosures of collusive acts of trade associations in the building-materials field. Is it not possible that this feeling will make itself felt in legislative halls, with the result that the publication of all figures collected by associations may be forced by law? In fact, will it not be fortunate if the people do not go to severely restrictive measures? The railroads followed a "public be damned" policy, and the public put them under drastic regulation.

As an instance of the displeasure caused by lack of frankness, take the cement industry. As we have stated before, we believe that a majority of engineers and contractors believe that the cement companies agree on prices; many believe that they restrict territories. If the industry were frank about its statistics—and had been frank about them for many years—the feeling toward the industry would be much better. The surprising fact is that the attitude of the industry has not changed. As far back as 1913, before there was an open-price association in the cement or in any other industry, *Engineering Record* sought to publish the statistics on production, stocks and shipments of the Association of American Portland Cement Manufacturers (the predecessor of the Portland Cement Association) but was refused permission. That was at least understandable then. But the request has been made since upon the officers of the Portland Cement Association, but without avail. Even the publication of these figures, which do not involve prices, would have tended to prevent the development of the present unfavorable feeling.

The policy, in our judgment, is shortsighted not only on the part of the Portland Cement Association, but of other trade associations, whether of the open-price form or not, which keep their statistics secret. In reference to the cement industry, it is of interest to note that an influential group of consumers recently discussed means by which an open cement exchange could be established—another direction in which public pressure may be exerted on industries which are mistrusted.

* * *

On the main question, however, of the legitimacy of trade associations which exchange information only on closed transactions, we have not yet had, it would seem to us, the last word of the court.



GENERAL VIEW OF TEST HIGHWAY AT PITTSBURG, CAL.
(Note embankment to be used later for flooding. The two lines of traffic move in opposite directions.)

Variety of Movements Occur In Concrete Test Highway

Cracks In Pavement Come On Crests of Longitudinal Waves—Edges Curve Up In Daytime and Down At Night—Test Continuing

DEFINITE results have become apparent even since Nov. 9, when motor truck traffic started tests to destruction of the reinforced concrete roadway built near Pittsburg, Cal. A statement of the types of pavement built and the scope of the tests was published in *Engineering News-Record* Aug. 18, 1921, p. 276 and a note announcing the beginning of traffic appeared Nov. 24, p. 873. Although new information is being added continually, records made prior to Dec. 1 consistently indicate the following: (1) Irregular longitudinal buckling or wave movement in the slabs, with "contraction cracks" occurring at the crests of the waves; (2) warping of the pavement cross-section, varying with the time of day, the edges cupping up at night and curving down in the daytime; (3) temperature differences of 6 or 7 deg. F. between top and bottom of pavement, the top being about 6 deg. colder in the morning and 7 deg. warmer in the afternoon. Another unexpected development is that at the end of four months of dry weather after the pavement was finished, the adobe subgrade under the center of the slab was found to have a greater moisture content than when the work was started. Laboratory tests showed this content to average 13 to 14 per cent by weight, and in one instance 27 per cent.

MAKING EXTENSOMETER MEASUREMENTS ON PAVEMENT SURFACE
(White spots in foreground on center line show location of mercury pockets where slab temperatures were taken.)

After two weeks of continuous and intermittent traffic a total of about 730,000 tons, chiefly in the form of solid-tired trucks, each with a gross weight of 14,500 lb., had passed over the pavement. Numerous transverse cracks had occurred before traffic started and after traffic began triangular breaks appeared at the shoulders on either side of some of the construction joints. There had been also some vertical movement between the corners of slabs where longitudinal and transverse joints met. All broken spots were being repaired so that tests might continue without subjecting adjacent paving to undue shocks because of the broken sections. For the most part the pavement was withstanding the heavy traffic satisfactorily. After the first heavy rainfall on Nov. 22 and 23 threatened breaks developed more rapidly.

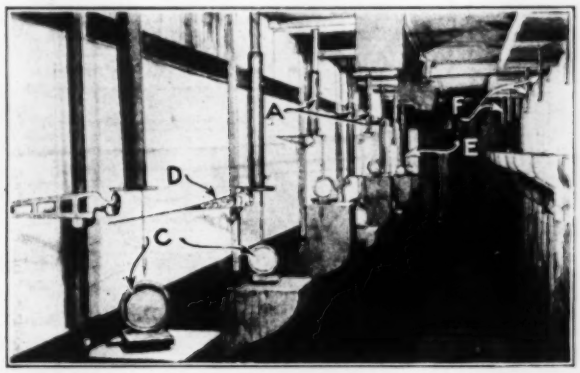
Records of slab and subgrade deflections are being compiled by means of rods imbedded in the pavement and subgrade, as shown in the accompanying drawing, and extending down into tunnels underneath the pavement where measurements are made. Four tunnels were put in, each under a different type of pavement. The tunnels are electrically lighted, ventilated by fans and have two-ply plank linings calked and tarred to make them watertight. When special tests are to be made, such as measurements of deflection under static or impact loads, observers in the tunnels make direct readings on dial micrometer gages, which are graduated to thousandths of an inch and can be estimated to ten-thousandths.

For continuous traffic, a recording pen on each of the nine rods marks on a moving paper the deflections of the slab caused by the procession of trucks. The paper is mounted vertically on the side wall, extends the full tunnel length and is rolled continuously from one drum to another by an electric motor. The arrangement of the direct reading and recording devices is such that either or both can be used without interference. The rods used to measure the subgrade deflection come into the tunnel on the opposite side from the pavement rods and movements of the subgrade are measured by direct reading gauges only.

The diagrams, four of which are reproduced on p. 1050,

show deflections caused by 5-ton trucks in various positions on the pavement, the position of the truck wheels being indicated on each diagram. The deflections are plotted in two groups and on two different scales, a single representation of the nine rod positions with respect to the pavement serving both groups of records. The line A-B is taken as the center line of the rods and also as a line of zero deflection of the slab. Deflections for 12-mile speeds are plotted in the direction A-B. The position of the front wheels of the truck with respect to the rods is indicated in feet on the extreme right of the diagram. The maximum deflections occur as the rear wheels pass over the rods, i.e., when the front wheels are in position + 13 ft., 4 in., or the length of the wheel-base past the rods.

These deflections increased as the traffic continued. That is, with loads, speeds and all conditions, including weather, just the same as at the outset of the test, the maximum deflections increased in the first week of 5-ton truck traffic from 0.019 in. to 0.030 in. The diagrams represent the conditions observed after six days of traffic, when the tonnage over the pavement had reached a total of 326,000 tons. This increased deflection, it is suggested, might have been due to the compacting of the subgrade which would give the slab more



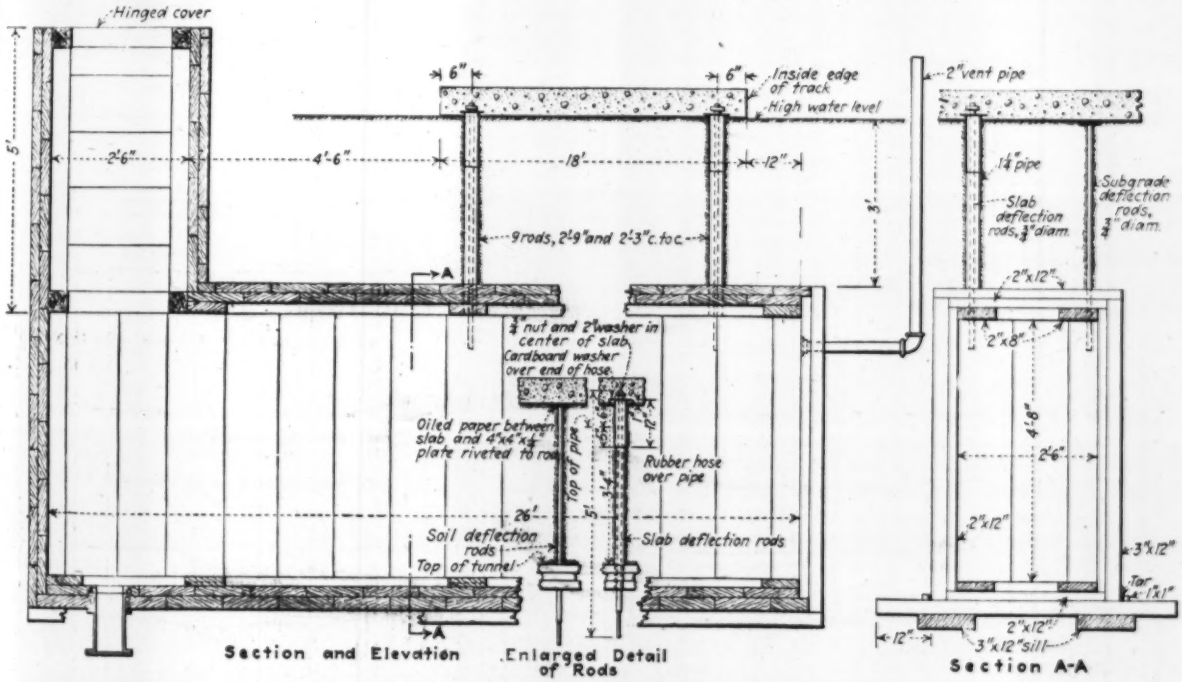
INTERIOR OF INSPECTION TUNNEL SHOWING ARRANGEMENT OF APPARATUS

(A—At lower ends of rods whose tops are imbedded in pavement; B—adjustable sleeve; C—dial for direct readings; D—recording pens for registering deflections on paper; E—one of the two drums on which paper is rolled. F deflection rods from subgrade.)

freedom of movement within the elastic limit. It was noted that the slow rate of return of the slab to normal position was about the same after long continued traffic as at the beginning of the test.

In the second group of deflections X-Y is taken as a line of zero deflection of the slab and for each truck position indicated, maximum deflections, as recorded by each of the nine rods, are plotted normal to X-Y. Atmospheric temperatures were recorded during all of the tests to permit of any corrections and comparisons on that basis which might be desirable.

Similar series of plottings are being made in each of the four tunnels, thus giving a comparison of similar results on different types of pavement. Section G, on which the measurements shown in the diagram were made, is 6 in. thick, reinforced on top and bottom with $\frac{3}{8}$-in. transverse bars placed on 7½-in. centers. Longitudinal bars, ½ in. in diameter, were used on top and bottom near each edge.



ARRANGEMENT OF RODS AND INSPECTION TUNNEL

The longitudinal waves in the pavement were discovered by making micrometer measurements of the surface elevations along both edges at 6 ft. intervals. This was done before traffic commenced, a series of observations being made daily for several weeks. Measurements were made by means of gages mounted so the surface elevations of the slab could be read with respect to the tops of rods driven into the earth close to the concrete. The waves varied in amplitude up to a maximum of about 1 in., this variation recurring daily at approximately the same time and place. The full

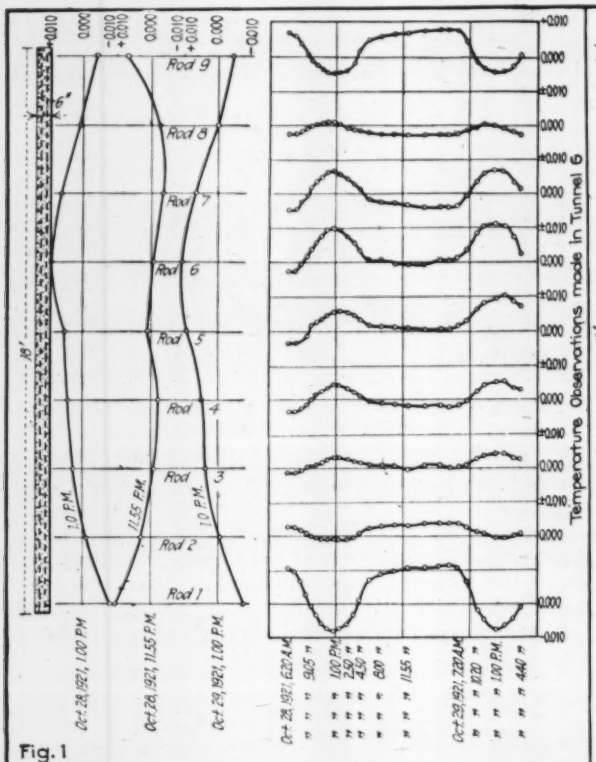


Fig. 1

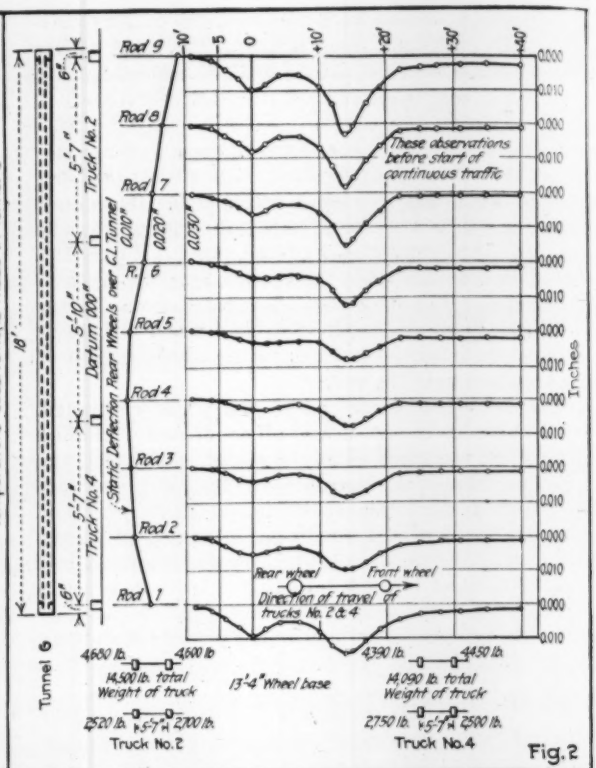


Fig. 2

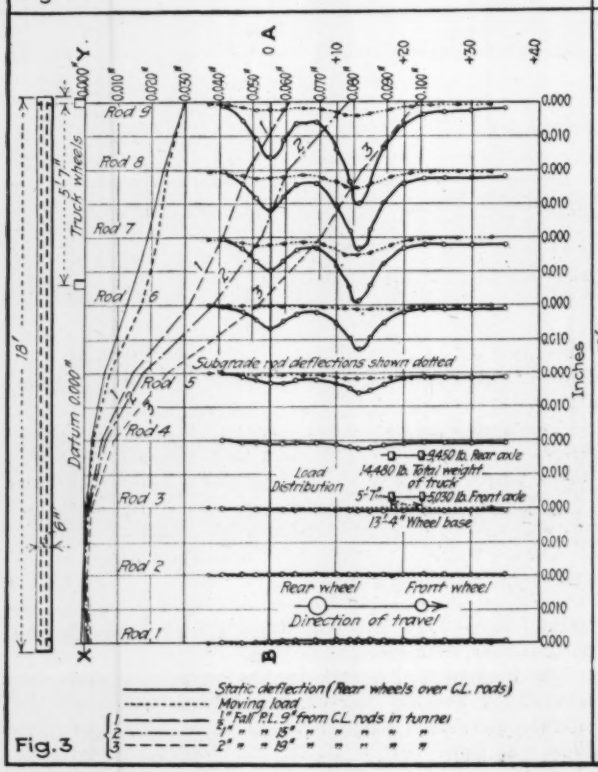


Fig. 3

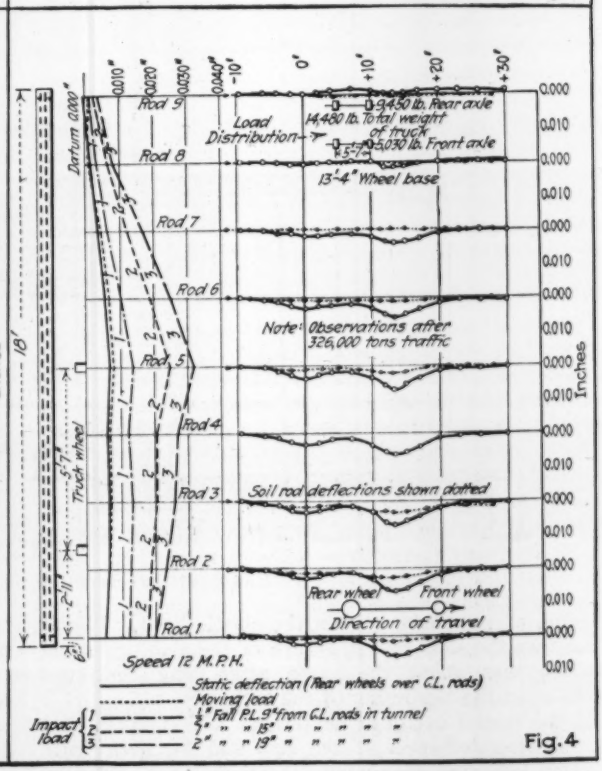


Fig. 4

GRAPHICAL RECORDS OF DEFLECTIONS DUE TO TEMPERATURE AND TO IMPACT, STATIC AND MOVING LOADS

Fig. 1—Temperatures. Fig. 2—Static Test, Two Trucks. Figs. 3 and 4—Static, Moving and Impact Tests.

(Note that (1) edge of slab does not return immediately to former position after truck passes close to edge; (2) maximum temperature deflections occur at shoulders; (3) with truck at one edge, opposite edge tilts upward.

range was covered within a period of about 7 hours, which was the time in which atmospheric temperatures varied from least to greatest. The amplitude of the waves was less in the middle of the sections than at the ends where construction joints occurred. This was believed to be due to the reinforcing which would tend

to resist bending within the section where it was continuous.

In practically every case where contraction cracks occurred on sections measured for longitudinal waves, the cracks were found at the crests of waves. In one case where the wave was not exactly at right angles to the center line, as shown by measurements on opposite sides of the slab, a small crack not previously discovered but which extended half way across the pavement to meet a crack already recorded, was found when careful search was made at the crest of the wave.

Temperature readings on the slab were also made in the weeks prior to the beginning of traffic. For this purpose two holes were drilled in the concrete for each temperature station, one ½ in. deep and the other to within ½ in. of the bottom of the slab. A small quantity of mercury was placed in each hole and the tops were closed with corks. To make readings the corks were removed and thermometers were dipped in the mercury for 1 minute, which was found to be long enough to give correct values.

Extensometer measurements were made, chiefly on the center line of the deflection rods, so that the deflections of the slab could later be expressed in terms of stresses. To facilitate accurate readings brass spuds were imbedded in the concrete in pairs, spaced convenient to the range of the instruments to be used. Because of the delicacy of these instruments and in order to avoid the personal equation involved in two separate readings, these measurements were taken first with the truck standing over the spuds and the observer with extensometer under the truck. After the reading the truck moved off, and the instrument was read again without the load.

A notation affecting construction or expansion joints has been made by observers as follows: When the rear wheels of a truck stood close to a construction joint consisting of a ½-in. board used as a transverse header between two successive concrete pours, some deflection was caused in the adjoining slab due to the shear transmitted through the joint. At times of highest temperature enough shear was transmitted to cause the adjoining slab to deflect 90 per cent of the amount found in the loaded slab. At times of minimum temperature the unloaded slab deflected only 10 per cent as much as did the slab carrying the truck.

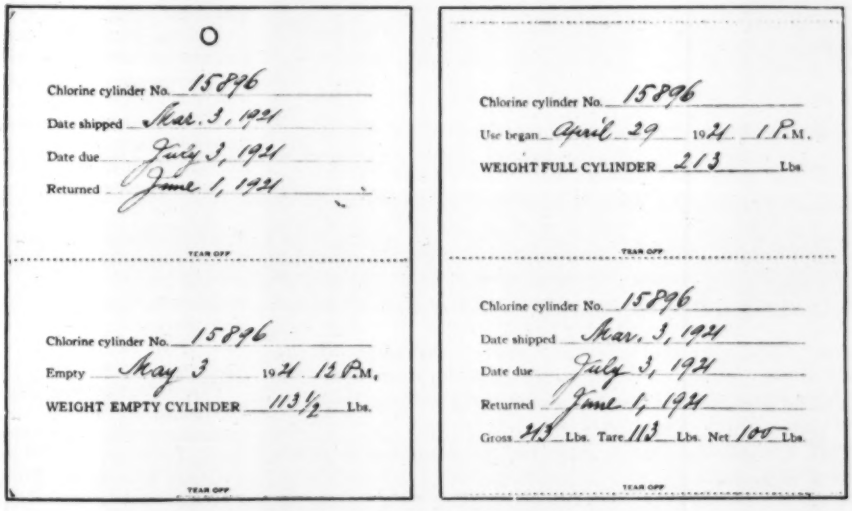
After the first rain laboratory tests on adobe taken from the subgrade under the slab showed the moisture content to have increased to 46 per cent. Simultaneously with this change the slab was found to have a better bearing on the subgrade and the deflections recorded were less.

The tests are being carried on under a co-operative plan, the major cost and the initiative being undertaken by the Columbia Steel Co. and aid being given by the U. S. Bureau of Public Roads, the California Highway Commission, the Automobile Club of Southern California and other interests. The engineering and field work are in the hands of Lloyd Aldrich and John B. Leonard. Harold Hammill has had charge of observations and records.

Keeping Track of Chlorine Cylinders

TO keep chlorine cylinders moving in their correct order through the plant of the Indianapolis Water Co., five 3x5-in. cards have been devised. They are made up in a long strip with perforations so that they may be detached and accompany the cylinder or be placed in the various files of the employees who may be concerned with the cylinder as it progresses from the freight station through storage to use and back to empty storage, thence to the freight station for return to the manufacturers. H. E. Jordan, superintendent of filtration, explains the use of the cards as follows:

Card 1, with 2 and 3 attached, is fastened to the cylinder upon arrival at the plant. It remains there until the empty cylinder passes into the freight house for return shipment.


Chlorine cylinder No. 15896
Date shipped Mar. 3, 1921
Date due July 3, 1921
Returned June 1, 1921
TEAR OFF
Chlorine cylinder No. 15896
Empty May 3 1921 12 P.M.
WEIGHT EMPTY CYLINDER 113½ Lbs.
TEAR OFF
Chlorine cylinder No. 15896
Use began April 29 1921 1 P.M.
WEIGHT FULL CYLINDER 213 Lbs.
TEAR OFF
Chlorine cylinder No. 15896
Date shipped Mar. 3, 1921
Date due July 3, 1921
Returned June 1, 1921
Gross 213 Lbs. Tare 113 Lbs. Net 100 Lbs.
TEAR OFF

DETACHABLE CARDS FOR CHLORINE CYLINDERS

On continuous strip; card 1 is upper left; card 2 lower left; card 3, upper right; 4, lower right; card 5, same as card 1.

Card 2 is filled out by the filter operator as soon as the tank is empty when it is sent to the superintendent's office where it is checked against the billed weight and then placed in the empty file, thus providing constantly data as to the number of empties on hand.

Card 3 is filled out by the filter operator when the tank is put into service and immediately sent to the superintendent's office, where it is checked against the billed weight and put into the "in use" file with card number next below.

Card 4 remains in the superintendent's "active" file from date of arrival of the cylinder at the plant until the empty is returned. It is first used for instant reference regarding reserve stock of chlorine. When the cylinder is delivering chlorine it is held in the "in use" file, but when the cylinder is empty the card is placed in the "inactive" file for reference until receipt is obtained from the chlorine manufacturer.

Card 5 is identical with Card 1. It is the purchasing agent's copy and is used by him to check the receipt of full and the return of empty cylinders.

International Division of St. Mary and Milk Rivers

Order of Joint Commission Alloting Waters for Irrigation and Power to United States and Canada—With Comment

AFTER hearings and postponements extending through more than six years the International Joint Commission on Oct. 5 adopted an order and rules for the measurement and apportionment of the St. Mary and Milk rivers and their tributaries in the State of Montana and the province of Alberta and Saskatchewan. The action was taken under and is an interpretation of a provision of the treaty between the United States and Great Britain dated Jan. 11, 1909. The interpretation and rules are in substantial accord with the way the water has been divided and measured by engineers of the U. S. Reclamation and the Canadian Irrigation services, under an interim order, as described in detail by Benjamin F. Jones, hydraulic engineer, United States Geological Survey, in *Engineering News-Record*, Dec. 30, 1920, p. 1277.

Article VI of the treaty provided that the two rivers named should be treated as one stream for irrigation and power purposes and that the waters should be divided equally between the United States and Canada, but that more than half might be taken from one stream and less than half from the other "by either country so as to afford a more beneficial use of each." It was also provided that between April 1 and Oct. 31 the United States should be "entitled to a prior appropriation of 500 sec.-ft. of the waters of the Milk River, or so much of it as constitutes three-fourths of its natural flow;" and that the apportionment of the water should be made jointly by the "reclamation officers of the United States" and the "irrigation officers" of Canada.

After citing the article just abstracted, and stating that the officers just named had been unable to agree as follows:

Rules on Apportionment

St. Mary River—I. (a) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is 666 sec.-ft. or less Canada shall be entitled to three-fourths and the United States to one-fourth of such flow.

(b) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is more than 666 sec.-ft. Canada shall be entitled to a prior appropriation of 500 sec.-ft. and the excess over 666 sec.-ft. shall be divided equally between the two countries.

(c) During the non-irrigation season the natural flow of the St. Mary River at the point where it crosses the international boundary shall be divided equally between the two countries.

Milk River—II. (a) During the irrigation season when the natural flow of the Milk River at the point where it crosses the international boundary for the last time (commonly and hereafter called the Eastern Crossing) is 666 sec.-ft. or less the United States shall be entitled to three-fourths and Canada to one-fourth of such natural flow.

(b) During the irrigation season when the natural flow of the Milk River at the Eastern Crossing is more than 666 sec.-ft. the United States shall be entitled to a prior appropriation of 500 sec.-ft. and the excess over 666 sec.ft. shall be divided equally between the two countries.

(c) During the non-irrigation season the natural flow of the Milk River at the Eastern Crossing shall be divided equally between the two countries.

Eastern Tributaries of Milk River—III. The natural flow of the Eastern (otherwise known as the Saskatchewan or Northern) tributaries of the Milk River at the points where they cross the international boundary shall be divided equally between the two countries.

Waters Not Naturally Crossing the Boundary—IV. Each country shall be apportioned such waters of the said rivers and of any tributaries thereof as rise in that country but do not naturally flow across the international boundary.

V. For the purpose of carrying out the apportionment directed in I, II and III hereof the said reclamation and irrigation officers shall jointly take steps

(a) to ascertain and keep a daily record of the natural flow of the St. Mary River at the international boundary, of the Milk River at the Eastern Crossing, and of the eastern tributaries of the Milk River at the international boundary by measurement in each case: (1) At the gaging station at the international boundary; (2) at all places where any of the water which would naturally flow across the international boundary at that particular point are diverted in either country prior to such crossing; (3) at all places where any of the waters which would naturally flow across the international boundary at that particular point are stored, or the natural flow thereof increased or decreased prior to such crossing.

(b) To fix the amount of water to which each country is entitled in each case by applying the directions contained in paragraphs 1, 2 and 3 thereof to the total amount of the natural flow so ascertained in each case.

(c) To communicate the amount so fixed to all parties interested so that the apportionment of the said waters may be fully carried out by both countries in accordance with the said directions.

Gagings Required

VI. Each country may receive its share of the said waters as so fixed at such point or points as it may desire. A gaging station shall be established and maintained by the reclamation or irrigation officers of the country in which any diversion, storage, increase or decrease of the natural flow shall be made at every point where such diversion, storage, increase or decrease takes place.

VII. International gaging stations shall be maintained at the following points: St. Mary River near international boundary; the North Branch of Milk River near international boundary; the South Branch of Milk River near International Boundary; Milk River at Eastern Crossing; Lodge Creek, Battle Creek, and Frenchman River, near international boundary and gaging stations shall be established and maintained at such other points as the commission may from time to time approve.

VIII. The said reclamation and irrigation officers are hereby further authorized and directed:

(a) To make such additional measurements and to take such further and other steps as may be necessary or advisable in order to insure the apportionment of the said waters in accordance with the directions herein set forth.

(b) To operate the irrigation works of either country in such a manner as to facilitate the use by the other country of its share of the said waters and subject hereto to secure to the two countries the greatest beneficial use thereof.

(c) To report to the commission the measurements made at all international and other gaging stations established pursuant to this order.

IX. In the event of any disagreement in respect to any matter or thing to be done under this order the said reclamation and irrigation officers shall report to the commission, setting forth fully the points of difference and the facts relating thereto.

We are informed by Mr. Jones that the only statement or figures in his article mentioned above that would be changed by the decision are in the table on p. 1279, and are that "Canada's share on Aug. 4 would be 502 instead of 500 sec.ft. and her deficiency 22 instead of 20 sec.-ft. on that date."

F. H. Newell, now consulting engineer, United States Reclamation Service, who served as one of the original

negotiators in drafting the treaty with Great Britain, has sent *Engineering News-Record* some comment on the order that promises to be of general interest. After citing the treaty provisions giving Canada 500 sec.-ft. priority in the St. Mary River during the irrigation season and the United States a like priority in the Milk River, and noting that because of natural conditions the Milk River priority granted this country is "relatively insignificant compared with that of Canada's priority in St. Mary River," Mr. Newell writes:

There is not enough water in either or both streams to supply all of the dry lands which may be economically irrigated. The growth and future prosperity of northern Montana and southern Alberta are tied up in the efficient use of the waters of these streams. A larger beneficial use can be secured by storing the waters of St. Mary River in Montana, in the natural reservoir sites in or adjacent to the Glacier National Park. It has been found possible to carry some of this water across the low divide into the Milk River drainage, supplementing the low water flow of this stream. Waters thus diverted in the United States flow, however, into Canada and then after following along north of the boundary for about 200 miles they return to the United States.

It would seem as though little difference of opinion could arise as to the methods of measurement and apportionment. The original draft of the treaty was to the effect that apportionment should be made of the waters at the international boundary. The specific designation was, however, left out of the treaty as finally signed for the reason, as asserted by the Americans, that the treaty referred wholly to such waters. The Canadians, however, attached great significance to this omission—of what the Americans regarded as surplusage—and contended that at the last moment the object of the treaty was changed so that the entire flow of both rivers should be taken into consideration, including tributaries of Milk River, which, coming from the south, have never been considered as international waters.

Moreover, the Canadians contended that the prior rights should first be measured and then the remaining waters apportioned equally. This also was considered by the Americans as practically rewriting the object of the treaty as regards equality of division, since the granting to the Canadians of a priority which was not to be measured as part of equality practically gave them the lion's share of the available supply.

The matter was argued by learned counsel at St. Paul in May, 1915, again at Detroit in May, 1917, and for the third time in Ottawa in May, 1920. By that time the members of the commission individually seemed to have got into a state of mind where agreement was impossible.

An interesting point to engineers is that when deadlock seemed certain the commission resorted to the simple expedient of declining to hear further argument, and instead of this decided to go upon the ground in person and see for themselves something of the situation, listening not to further legal discussion but finding out for themselves, through talking with the people of the country and the engineers, what are the actual facts and what are the relative merits of the various contentions made.

Accordingly the commission invited counsel to remain away and listened to the informal statements of fact made by irrigators in the Milk River Valley in Montana and in the St. Mary area in Canada. The result was a brushing aside of technicalities and an immediate reaching of an understanding.

It required only a few minutes' talk on the part of well informed farmers and ranchmen to show that the proposed consideration of the southern tributaries of Milk River in the proposed equal division was a practical absurdity. These streams shrink soon after leaving the high lands and cannot and should not be considered as part of a dependable water supply.

In the same way the contention of Canada for a priority in St. Mary River was emphasized in the minds of the commission by the plain, simple statements of men living on the ground and using the water.

The result is that although Canada may get theoretically a larger proportion of the available supply of St. Mary River, yet the people of the United States will probably receive all that can be economically stored for their use. Each party can claim a substantial victory. The ground is now clear for the development of plans for water storage in Montana for the benefit of lands in Alberta. . . .

After again remarking on the more than six years spent in discussing this problem without reaching a decision, and noting that a compromise was finally reached only after the members of the commission had become convinced that "it would be little short of a calamity not to agree," Mr. Newell says in conclusion:

If it should be said that it was impossible for six English speaking people to interpret and apply the terms of a treaty written in plain English, then it might be claimed with some show of reason that it would be impossible to carry out other treaties between nations speaking different languages. In one sense the whole world was interested in showing that two nations living side by side can agree on waters flowing across the boundary and on other matters of vital importance to their citizens.

Two days after the above order was handed down the Commission recommended to the respective governments that both countries unite in building a storage reservoir at St. Mary's Lakes in Montana but that the United States proceed with the construction of the proposed Chain-of-Lakes reservoir in Montana and Canada with the proposed Verdigris Coulee reservoir in Alberta.

Kings River Water-Right Litigation Halted by Engineer's Plan

CLAIMANTS to water from Kings River, California, have agreed on a program drawn up by a committee of engineers under which all litigation will stop for the 1922 season and a plan be devised for utilizing more fully than heretofore the available waters of the river. The following information on the subject has been supplied to *Engineering News-Record* by J. B. Lippincott, consulting engineer, Los Angeles:

Kings River in California supplies a fair water-right to about 800,000 acres of high-grade land and a very defective water supply to about 400,000 acres more. Considering the crop values it is probably the most important irrigation stream in America. The water is distributed by twenty-two different canal systems. There has been a chronic condition of litigation over the division of this water for the past thirty years. An effort is being made to build a good storage reservoir and power plant for the purpose of conserving flood water and pumping from underground supplies so as to furnish an adequate supply for the whole 1,200,000 acres of land. A law was passed at the last session of the California legislature providing a legal method for irrigation districts, mutual water companies and privately owned canals in a given drainage basin to co-operate for such a purpose. Preliminary steps have been taken to proceed with the formation of this super-district.

In the meantime old litigation over the division of the water of the river was revived by a certain decision of the State Supreme Court and the stage was set for a renewal of the legal fight between a number of these canal companies which would interfere with, if not entirely prevent, a constructive program. A committee of engineers appointed for the super-district, composed in part of Louis Hill, George L. Swendsen and J. B. Lippincott, proposed a plan to avoid litigation and to proceed with the engineering studies looking toward construction. They proposed that the California State Water Commission, now known as the Division of Water Rights, should be called upon to prepare,

out of court, a temporary schedule for the division of the water of Kings River for the year 1922 and that all parties using water from the river should agree to accept this schedule and to permit the officers of the state to take charge of their headgates and operate them for this year. At the end of the year any one of the canal companies was given the right to withdraw from the agreement if it desired, or to petition the State Water Commission to revise the agreement for the following year. All claimants to water from Kings River have signed an agreement to desist from litigation over the water of Kings River until after the year 1922. In the meantime, the engineering committee is to proceed with its investigations and estimates, and it is believed that a plan will be developed whereby an adequate water supply will be maintained for the 1,200,000 acres which, if demonstrated, will largely relieve the tension now existing between the canal companies over the division of the water. If the program can be carried out to a successful conclusion, it will be a distinct accomplishment of a constructive nature and an avoidance of litigation which almost invariably has been destructive in its effect on irrigation development in the arid region.

London's Rapid Transit Mail Distribution System

Construction Now Going on—Automatic Electric Trains to be Transporting Units—Twelve Post Offices to be Linked

(LONDON CORRESPONDENCE)

(The project for mail distribution in London herein described is similar to the automatic electric system of freight transportation proposed for the New York Metropolitan District by the New York-New Jersey Port and Harbor Development Commission, and included in the "Comprehensive Plan" of the Port of New York Authority. The commission's plan was made public Jan. 24, 1921, and a resume of its general features was contained in "Engineering News-Record" of Jan, 27, 1921, p. 183.—Editor.)

IN ORDER to speed up the London mail services an underground electrically-operated railway is being built which will ultimately link up the chief post offices and trunk-line depots in the London district. The project is indicated on the accompanying map which shows both the present construction and the ultimate development. The plan has been worked out by the engineering department of the London post office and Mr. Dalrymple-Hay. Post office engineers are responsible for the electrical equipment and Mr. Dalrmyple-Hay is taking charge of the tunnel construction.

As shown on the map the Western Central District post office, the Mount Pleasant sorting office and the general post office at King Edward building will constitute important junctions when the extensions are undertaken. Between the stations shown the railway will consist of two lines of 2-ft. gage track, one eastbound and the other westbound, and each contained in a single tube of an inside diameter of 9 ft.

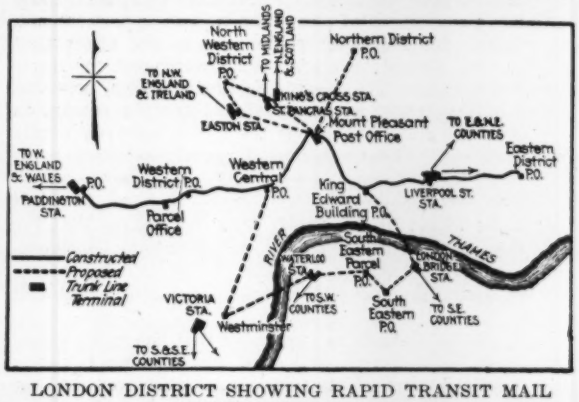
The trains running over this system will be operated without drivers on the remote-control system. It is proposed by the post office engineers to operate the trains by means of three types of electric current: high speed (HS), intermediate speed (IS); and low speed (LS). When the train is running between stations HS current will be applied. At the approach to a station the cars will pass over a short gap in the conductor rails and brakes will be applied. These brakes will be released electrically when the train is taking up the current and applied when the train is not. The next section after this of conductor rail will be normally dead and will be constructed of such a length as to allow the train to come to rest, the brake still remaining in operation.

If it is required to stop a car at a station LS current will be applied to this brake section and the train will move to the station platform where it will finally stop by the application of the brakes as it reaches that section of conducting rails rendered dead for its reception.

When a train is to skip a station IS current will be applied to the brake section and the train will pass through the station at this speed, passing over a short gap in the conductor rails and onto those sections of the line energized by HS current.

When it is possible to accept without delay a stopping train or an express the braking section or a portion of this line will be supplied with IS or LS current before the train reaches the station, in which case the train would merely be slowed up to a speed commensurate with the current supplied and would either proceed to the platform or skip the station.

Trains will be started by energizing the rails of the subsection on which they are standing with IS current



LONDON DISTRICT SHOWING RAPID TRANSIT MAIL DISTRIBUTING PLAN

if it is run on the main line or with HS if it is to be used for shunting purposes.

Cars will be moved into sidings and stopped at certain sections in the same manner as that employed to stop them at station platforms, and a device will be supplied for automatically reversing the connections of the car motors so that they may be easily coupled up to form trains of two or more cars. When thus connected the shoes of the rear car only will pick up the current, but all of the motors will be doing part of the propulsion.

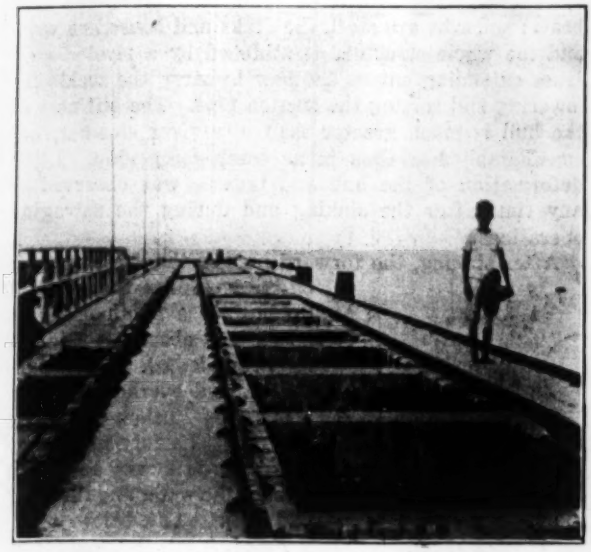
It is not intended that the control of the cars as they stop at, or pass through, a station need the continuous attention of switchmen. The position and destination of each train will be indicated to the switchman who will, with levers, set the line points for any specified route and will energize the conductor rail sections with the current needed. The operation of the line points will be interlocked with the current application and a complete interlocking system will be in force between the different routes.

Between the stations the conductor rail will be divided into sections, and while running between stations and before coming under the control of the switchman, the train will itself render each section dead as it leaves it and will energize it again upon entering the next section. This is provided to secure a dead-rail section between adjacent trains.

Open Pier Deck To Resist Storms

By H. H. Braun
Engineer-Constructor, Manila, P. I.

IN MANILA BAY there is a concrete pier, built in an exposed location, on which it was necessary to evolve a special design of deck to resist the heavy seas. When



LOOKING ALONG THE PIER FLOOR

a typhoon escapes and runs amuck over the China Sea, as frequently happens here during the months of July and August, the waves roll in at the site to buffet the pier with incredible violence.

The pier, which carries a double-track railway, is a reinforced-concrete slab and girder deck, founded on precast concrete piles. It is built in the form of an L. A stem 400 ft. long by 21 ft. wide leads out to the pier head which is 160 x 30 ft. The water is 24 ft. deep at low tide with the deck 12 ft. higher. The bottom is good firm sand where satisfactory penetration was obtained. Batter piles were driven for side bracing.

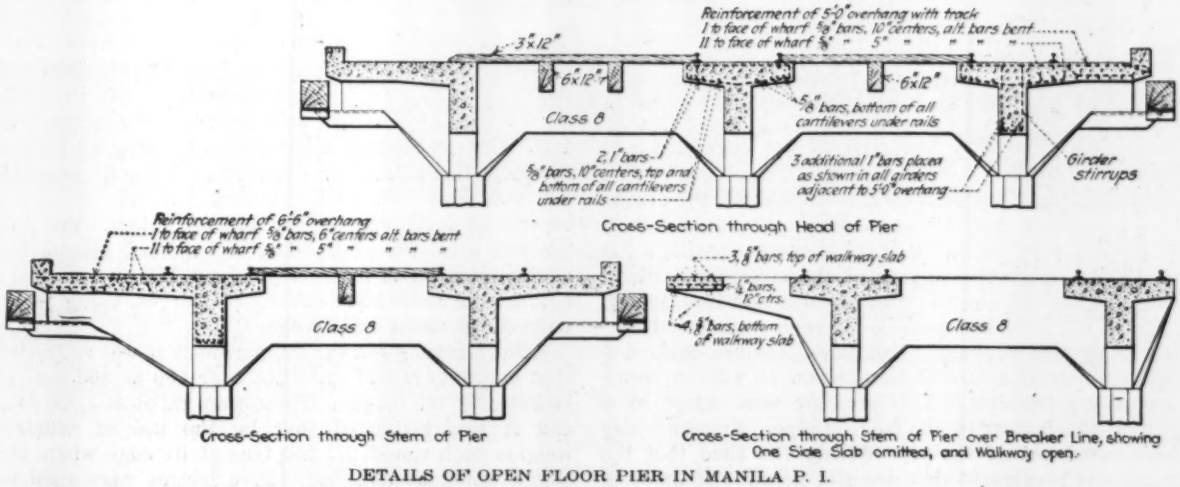
It was not deemed safe to build a solid deck. Accordingly the piles were spaced to center under the center line of each track, and are connected by heavy longitudinal T-beams, the head of each being just wide enough to carry its respective track. The longitudinal beams connect at deck level with the heavy cross girder pile caps, the space between the beams being left open. The head of the pier is widened to a three pile bent, as shown in the detail drawings, the deck being left entirely open in a similar manner.

The concrete work then, practically consists of a modified trestle, with flat-slab extensions along each edge. Joists, 6 x 12 in., are placed lengthwise of these openings, supported by proper metal hangers at the pile caps. Over the openings is placed a decking of 3 x 12-in. plank, which is free to lift off and go overboard in case of severe storm.

Where the stem of the pier crosses the breakers it is peculiarly liable to damage. It was necessary to protect the shore by heavy riprap upon which the waves break and surge high above the pier with savage violence. On this section the flat slab was omitted entirely on one side, and the walkway slab on the other side provided with longitudinal openings 9 ft. x 1 ft. 6 in. wide which are covered with 3 x 12-in. panels.

The wisdom of this design has been amply demonstrated through the eight years it has firmly withstood the destructive typhoons which sometimes sweep in across the China Sea. The writer has seen many waves strike this pier and throw tons of water far above the deck. The effect under a solid deck would probably be disastrous. Many times the wooden decking has been wholly or partly heaved up and flung far overboard. To replace this decking is, of course, expensive but in ordinary rough waters such as obtain on the coasts of the United States, it would be carried away only in very exceptional storms.

It is obvious that this design would be useless where deck loads must remain on the pier during storms. It is a satisfactory construction for wharves built in exposed places, such as pleasure piers, or others where it is practicable to remove the deck load during danger.


Reinforcement of 5'-0" overhang with track
I to face of wharf 5/8" bars, 10" centers, alt. bars bent
II to face of wharf 5/8" " 5" " " " "
3"x12"
6"x12"
6"x12"
Class B
5/8" bars, bottom of all cantilevers under rails
2, 1" bars
5/8" bars, 10" centers, top and bottom of all cantilevers under rails
3 additional 1" bars placed as shown in all girders adjacent to 5'-0" overhang
Girder stirrups
Cross-Section through Head of Pier
Reinforcement of 6'-6" overhang
I to face of wharf 5/8" bars, 6" centers alt. bars bent
II to face of wharf 5/8" " 5" " " " "
Class B
Cross-Section through Stem of Pier
3, 5/8" bars, top of walkway slab
1/2" bars, 12" ctrs.
4, 5/8" bars, bottom of walkway slab
Class B
Cross-Section through Stem of Pier over Breaker Line, showing One Side Slab omitted, and Walkway open

DETAILS OF OPEN FLOOR PIER IN MANILA P. I.

Russia's Skilled Workers

According to a survey made by the American Relief Administration among Russia's population of approximately 131,000,000, there are 4,675,400 men who are expert in mechanical and other branches of the various trades. Here are a few figures compiled by the relief workers in Russia: Electrical workers, 2,250,000; railway workers and employees, 1,215,000; transporters, 315,000; rural, 394,000, and miscellaneous, 501,400.

Sunken Dredge Raised by Jacking From Dry Dock Pontoons

Four Pontoons Lying on the Quarters Swing Hull in Rope Slings—Steel Truss Stiffens Dredge Against Damage

By James H. Polhemus
Chief Engineer, Port of Portland, Portland, Ore.

USING four sectional dry-dock pontoons, a dredge, displacing 1,600 tons and belonging to the Port of Portland Commission, Oregon, which had sunk in 25 to 40 ft. of water in the Willamette River, was raised in 16 hours after the salvaging equipment was in place. The entire operation of installing the equipment and raising the dredge took ten days. Some of the details of the operation were novel and all were devised and carried out by the Port engineers with available equipment. The cost of the operation was $40,000.

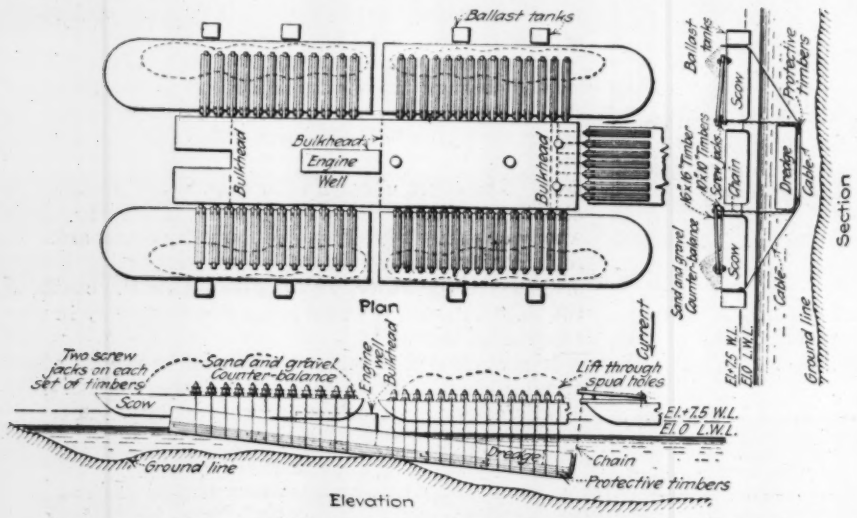


FIG. 1. ORIGINAL PLAN OF RAISING BY BARGES, JACKS AND SLINGS

At the time of the accident, March 4, 1921, the dredge was excavating gravel and pumping through 1,060 ft. of floating pipe and 1,520 ft. of shore pipe, with a lift of 18½ ft. above the surface of the river. The direct cause of the sinking was a break in a cast-iron 45-deg. bend in the discharge pipe in the hold, while the dredging pump was running. Excessive pressure broke out bodily an opening of oval form, about 15 x 28 in. measured along the axes. This pressure was caused by a plug at the far end of the floating pipe. Enough water had leaked out of the pipe during the time that the pump was previously shut down to permit the water in the pipe to gain momentum when the pump was started and the sudden check of this moving water caused hammer sufficient to break the pipe. To prevent plugs in the pipe line the invariable practice had been to pump clear water just before stopping the pump. For some unexplainable reason in this instance this method had failed to produce the desired effect.

Just previous to the accident, manganese steel bends had been ordered and were to be installed. The Port's more recently constructed dredges are so equipped and also have hydraulically operated gate valves on the suction pipe at the entrance into the hold. The bend which broke is probably the one most subject to wear and is inspected and replaced at regular intervals, but probably, due to the unusually eroding character of the material, the wear had been greatly in excess of the average.

Conditions of the Accident.—The hull of the dredge is 34 x 206 ft. x 10 ft. 6 in. deep with a displacement of 1,600 tons. The skin is of ⅜-in. steel plate, the deck beams and ribs are steel, the decks and house are wood and the whole structure is stiffened by a riveted steel truss extending out on the bow to carry the tackle for lowering and raising the suction pipe. The stiffness of the hull is much greater than in a river steamer, but considerably less than in an ocean-going ship. Little deformation of the hull and trusses was observed at any time after the sinking and during the salvaging operations.

After sinking, the forward part of the dredge rested on the level area which it had dredged to a depth of about 25 ft., and about one-third of its after length was unsupported, and overhung ground about 40 ft. below the water surface. The forward end of the main deck was about the level of the water and the after end about 10 ft. below.

Flood Upsets Original Plans.—Various plans for salvaging were considered and discarded. Cofferdamming was not feasible on account of the depth of water at the stern of the dredge and because of the expected spring freshet. Its great cost also caused other methods to be preferred. Lifting by the aid of the tides was not possible as the variation of tidal heights was not over 1 ft. Construction of a bulkhead extending all around the outer line of the main deck and raising by pumping out was also tentatively planned but was discarded because of doubt whether the hull was intact. The plan adopted consisted of building a bulkhead around the engine-room hatch and pumping out this compartment and, at the same time raising by barges, using jacks, with slings under the dredge.

After pumping out the compartment it was estimated that buoyancy would leave not over 600 or 800 tons to be lifted by the barges. These were rated at 1,000 tons and it was estimated that by the use of counterweights each would lift 250 tons at its edge where the slings would be attached. Five barges were used as shown by Fig. 1.

As indicated, the barges were equipped with timbers extending across-deck, fastened down at one end and overhanging about 2 ft. on the side nearest the dredge. House-moving jacks were placed as shown to lift the ends of the slings under the dredge. The slings consisted of wire ropes to which chains were attached at the ends for use with the lifting gear. At the turn of the bilge of the hull, wooden pads 6 in. thick were fastened under the slings. The general plan was to raise the dredge so that it could be moved into shallow water and be beached and if the main deck could not

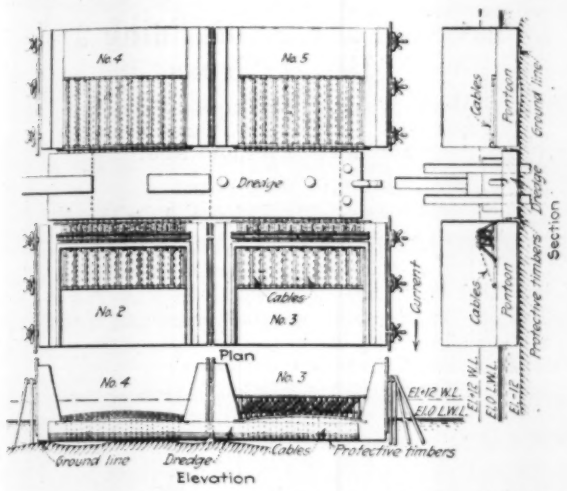


FIG. 2. SUCCESSFUL PLAN OF RAISING BY DRY-DOCK PONTOONS

be brought above the water by this means, at least the compartment could be bulkheaded and pumped out. The method of raising with the house-moving jacks was to lift a small distance and hold the distance gained by a pin through a link of the chain or by a U-bar holding against a link. Five days' time was taken in preparation for raising by this means.

The barges were in place and a heavy strain had been placed on the slings and the operation appeared to be on the eve of success, when there was an unexpected and rapid rise in the river. The total rise was about 10 ft. In one night the rise was so great as to cause the barges to careen and require the chains to be unfastened to prevent overturning or shifting the ballast. A freshet of this height was not to be expected and seldom has occurred at this date so it had not been prepared for in the plans for salvaging.

When the barges were cut loose the forward end of the dredge sank and the bow compartment filled, leaving the keel almost level or about 3 ft. down by the stern which hung unsupported for a distance of about 90 ft.

Successful Salvaging Operation.—With the failure of the first plan, it was decided to make use of four of the five sectional pontoons composing the port's 10,000-ton dry dock. These pontoons are 80 x 112 ft. over all and 80 x 82 ft. on deck, with wings extending about 40 ft. above the deck. To permit the pontoons to rest on an even bottom at, or lower than, the ground supporting the sunken dredge, the bottom of the river was

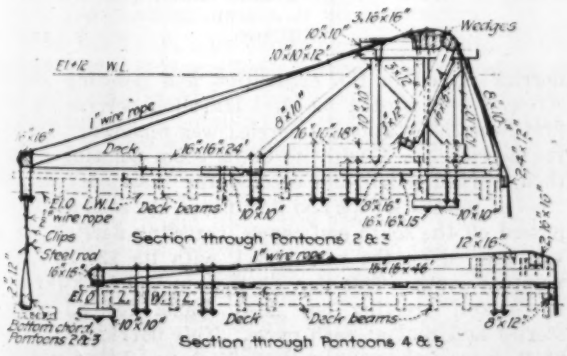


FIG. 3. SUPPORTS FOR SLINGS, ERECTED ON PONTOONS

dredged on both sides of the hull to an elevation of 14 ft. below low water. Pile clusters and connecting wales were placed as shown by Fig. 2 to hold the pontoons in position, at the same time wire rope slings were placed under the dredge, by pulling and sawing the bights from both bow and stern. Pads of 6-in. lumber were placed under the slings at the turn of the bilge as in the first operation. In the meantime the timber structures, Fig. 3, for attaching the wire rope slings to the pontoons were being erected at the port's dry dock and repair plant.

For the pontoons (4 and 5, Fig. 2) placed upstream from the dredge, the structures consisted of cross-sills to hold the loops of wire rope slings, which were held in place by sills attached to the deck beams of the pontoons by pairs of screw bolts passing through 1-in. steel plates against the lower side of the deck beams. At the end of the pontoon next to the dredge a timber was placed to protect the pontoon and to distribute the pressure transmitted by the wire ropes.

On the pontoons, 2 and 3, on the downstream side, heavy trusses were constructed extending across the length of the deck and to an elevation of 14 ft. above deck. The design of these trusses provided for: (1)

FIG. 4. TENSION ON SLINGS EQUALIZED BY WEDGING

Distribution of the strains on the deck of the pontoons; (2) possible concentration of loads at one point and movement of trusses in the direction of their length and change in direction of strains. An inclined strut was placed at the angle of the resultant pull of the wire ropes and additional inclined struts were placed to take strains which might occur otherwise than in the direction computed. The vertical resultant of the inclined pull of the wire ropes on the timber, back of the truss, was considered to require the wire rope ties under the deck connecting the upper and lower chords of the pontoon trusses.

When the pontoons were towed into position the wire rope slings were attached to the upstream pontoons and these pontoons were sunk. One end of the double slings was then carried around the back timber and both ends brought to the top of the truss and the downstream

pontoons were sunk. Final adjustments of the wire rope slings consisted in pulling taut with a 8½ x 10-in. donkey engine and attaching clips. When all the ropes were brought up tight, the pontoons were partly pumped out so as to raise them about one foot. They were then sunk in place and the resulting slack was taken up by driving wedges under the wire ropes on the top timbers of the trusses, Fig. 4, thus equalizing the strain on all the wires. Not less than five malleable iron clips were used on each connection. The height of the trusses was such as to permit all final connections and adjustments to be made above water.

The weight of the dredge was estimated at 1,600 tons, as computed by displacement afloat. The number of

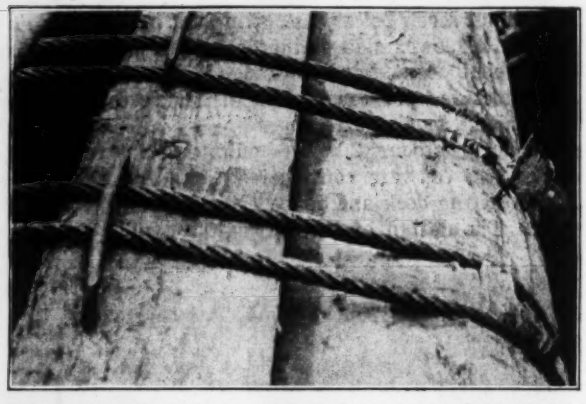


FIG. 5. SLINGS UNDER STRESS BITE INTO SUPPORTING TIMBERS

slings of 1-in. wire rope was 112, the average working strain of wire rope thus being about 7 tons. A strain of double this amount could be carried. The total lifting capacity of each pontoon was estimated at 2,200 tons.

By pumping out the compartments nearest the dredge and keeping the farther compartments filled, it was computed that each pontoon would lift approximately 400 tons and would then raise the dredge so that its main deck would be well above the water surface, both of which assumptions proved to be correct.

Raising was accomplished by pumping out all four pontoons simultaneously, the pumping being stopped at times on one pontoon, or water admitted, in order to keep the dredge level. The main deck of the dredge at the bow emerged in about 3½ hours and the dredge was finally floated at its normal draft about 16 hours after operations began. About ten days were consumed from time of beginning operations until they were successfully completed. Examination of the hull and working parts of the salvaged dredge showed little damage by the sinking and subsequent days of immersion.

The entire salvaging operation was conducted by the Port's regular organization under the direction of James H. Polhemus, general manager and chief engineer. The many engineering details, the computations and the preparation of the pontoons were carried out under the direct supervision of assistant engineer, H. L. Gilbert. The Port's Repair and Dry Dock Department under James Healy, master mechanic, did all of the field work and was directly responsible for the operation of raising. Much credit is due these men and the dockmaster, J. A. Stephens, who directed the actual operation of raising.

Erection of Steel Building and 150-Ft. Truss

Special Methods for Huge Truss—Derrick on First Floor with Long Boom Places Framing for Six Stories and Roof

By W. J. Howard
Engineer, Kelly-Atkinson Construction Co., Chicago

ERECTING THE LARGEST TRUSS ever used in a building was the major problem in the erection of the structural steel framing of the U. S. Mail Terminal at Chicago. The truss is of 150-ft. span and weighs 365 tons complete, with field rivets. All material for the structure was placed by two derricks traveling on the center line of the building at the first floor level. The building, which is a unit of the Union Station project, is 792 x 72 ft., paralleling the approach tracks and with its ends fronting on Van Buren and Harrison Sts. (See *Engineering News-Record*, Dec. 15, 1921.) It comprises a track or train floor, six upper floors and roof, with a total of 7,650 tons of structural steel, of which 2,800 tons is in the track floor and first floor.

Owing to the very limited space available, a material storage yard was established about half a mile south of the site. All steel was unloaded, checked and sorted at this yard, and then reloaded on cars for movement to the work as required for erection. This yard handling was done by derrick cars.

Two steel stiff-leg derricks mounted on platforms traveling on a single track of 36 ft. 7½ in. gage on the first floor framing performed practically all the erection work. The first two-panel section, 56 ft. in all, of the south end of the building up to and including the first floor, was erected by a stationary 15-ton wood stiff-leg

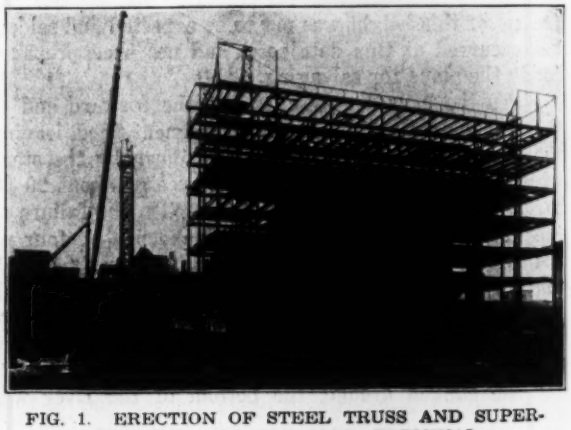


FIG. 1. ERECTION OF STEEL TRUSS AND SUPERSTRUCTURE OF U. S. MAIL TERMINAL; CHICAGO

derrick placed in the excavation and pointing south. After it had erected the first traveling derrick on the first floor this stationary derrick was removed. Traveling derrick No. 1, with its 90-ft. boom pointing north, then worked north and erected the remainder of the steel of the track floor and first floor. As soon as it had passed off the south end panels, traveling derrick No. 2 was erected on the same track with its 130-ft. boom pointing south. This derrick then moved backward or northward, erecting one 28-ft. panel for all upper stories and roof at each move. This derrick was kept 28 ft. beyond the nearest line of columns being erected. Fig. 1 shows the steel erected on the truss near the

south end of the building, with the tall derrick at the left.

Traveler No. 1 has completed its work and has been removed. When No. 2 reaches Van Buren St. to finish the end of the building, it probably will be run out into the street, as this thoroughfare is now closed to traffic during the erection of the new approach to the Van Buren St. bridge. If the street should have been opened at that time, the erection scheme shown in Fig. 2 will be used. The derrick will be dismantled within the building line by a 75-ft. wood boom placed in a special swivel boom seat casting which will be attached to a column on one side of the center line of the building, at about the third-floor level, utilizing the column as a mast. This boom will then erect the steel for the remaining end panels of the building.

A special problem in erection was presented by the 150-ft. truss, with its two 37-ton columns. This truss

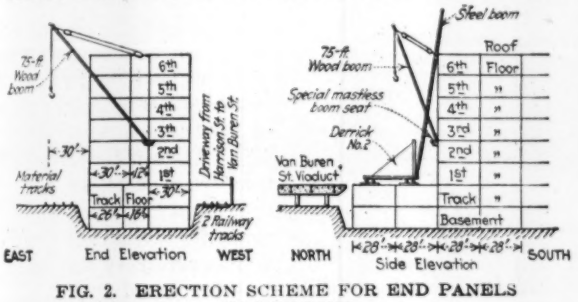


FIG. 2. ERECTION SCHEME FOR END PANELS OF BUILDING

is in the west wall, spanning an opening for a cross-over track which leads into the building. It is 25 ft. deep c. to c. of chords, with its bottom chord below the first floor and its top chord above the second floor. As shown in Fig. 3, when the two columns are held at base and track floor, the bottom chord draws each column $\frac{5}{16}$-in. inward while the top chord pushes it $\frac{5}{16}$-in. outward from the vertical center line. Thus the combined movement is $\frac{5}{8}$-in. in each direction.

It was proposed originally to place $\frac{3}{4}$-in. pins in the top and bottom chord connections to the columns, following these with pins increasing by $\frac{1}{16}$ in. in diameter until the connection was made finally with $1\frac{3}{4}$-in. pins, after which the rivets could be placed in the $1\frac{1}{16}$-in. reamed holes. This plan was simplified, however, by the unusually favorable conditions of frosty mornings and hot afternoons, which made it possible to take advantage of the expansion and contraction of the steel. Thus the $\frac{3}{4}$-in. pins in the bottom chord connections were replaced with $1\frac{3}{4}$-in. pins on a hot afternoon, and on the following cool morning $1\frac{3}{4}$-in. pins were placed in the top chord connection.

With the $1\frac{3}{4}$-in. pins replacing the $\frac{3}{4}$-in. pins in the bottom chord during a hot afternoon, the only effect of the stresses due to contraction and expansion on the following cold morning would be to bend the columns, which was what we were trying to do. The column was free to move at the bottom chord line, as it is connected to the frame of the building by slotted expansion holes, and probably it did lean away from the truss due to expansion of the bottom chord. When the full load is applied and the bottom chord lengthens either the columns will move or the chord will be crushed or the rivets attaching the chord to the columns will be sheared. It is to be presumed that the designers took this force into account.

FIG. 3. CAMBER EFFECT IN TRUSS ERECTION

In the falsework for the truss erection the double bottom sills of the bents were of white oak, with white oak wedges set half way through the opening between the sills to allow of raising or lowering the falsework if required. The camber blocking on the bents was of soft fir and was of twice the camber called for in the riveted truss, so that while the truss would be amply supported, it could be crushed into place as the connections were pinned. At one bent the cap itself was crushed by the pinning of the diagonal members.

In a double-intersection truss like this, there would not be ordinarily enough flexibility for any camber beyond the reamed camber. But we did not make the diagonal connection to the top chord until the truss was erected complete and had settled, so that there was very little drifting required to force the truss to the reamed camber. The original plan required the center section of the top chord to be erected before the end sections, but this method was changed to enable the diagonal connections to be left until the last.

In shop assembly, the truss connections were reamed in the unstressed condition. This did not cause trouble nor distort the columns in making the field connections, since the truss was not connected to the columns (except for some few $\frac{3}{4}$-in. bolts) until after the truss had been riveted, with the exception of its top-chord splices. The reamed holes matched perfectly so that there was no such excessive dirfting as might be inferred from the crushing of the cap, mentioned above. This cap had been reduced in section by splitting portions away, for the reason that the camber blocking on top of the cap was hard to get at for splitting. Therefore the cutting away of the cap to cause it to crush was the easiest method of allowing the necessary settlement.

Since the whole truss had been assembled and reamed at the shop, it was bound to take its assembled position in the field. The erector's problem was to guess the amount of settlement, to camber the truss as high as possible to assist in making the top-chord connection, then to pin the truss down and crush the camber blocking, and finally on a hot day to make the bottom chord connection. This plan was followed successfully. The truss as erected had $2\frac{3}{4}$-in. camber, but $\frac{3}{4}$-in. of this was lost when the steel superstructure was erected on it. It is expected that 1 in. more will be lost under the full dead load of the concrete floors and the walls, leaving 1 in. camber in the truss when the building is completed.

By cambering the truss as high as possible we were aided in making the top-chord connections. It will be realized that $\frac{1}{16}$-in. is sometimes a great assistance in such connections. It may be noted that in the erection of the Mississippi River bridge of the St. Louis-San Francisco Ry. at Memphis, Tenn., one of the closing sections of the top chord was brought to the traveler packed in ice, and the bottom chord was surrounded by hot steam pipes.

Cambering the truss higher than called for was done partly to allow for settlement of falsework and because it is easier to lower than raise camber. Although, as stated above, it was necessary to pin one point until the cap crushed, this did not necessitate any excessive amount of pinning that would distort the metal, because

if one point was higher than those on either side of it, it must have more weight on it and all the pinning would do would be to help this excessive weight crush the camber blocking until all three points had an equal bearing against the bottom chord.

The center section of the bottom chord weighed 42 tons and the center section of the top chord 40 tons. It was necessary to keep the first or small derrick 55 ft. from the farthest necessary reach of the 70-ft. boom and we were unwilling to subject the derrick to this overload. For making these two lifts, therefore, a 15-ton wood derrick with 70-ft. boom was placed on the track floor and used to take 12 tons of the load by calculating the point of lift on the chord for each derrick. The steel derrick was hooked to the chord at a point 19 ft. 3 in. from one end and the wood derrick at a point 12 ft. 3 in. from the other end, the chord being lifted in a vertical position and then lowered into its horizontal position in the truss.

There were over 11,000 tapered field rivets of 1⅛-in. diameter in this truss, and some of these were 11¾ in. long. They were all driven by an air hammer and bucked up by air jams. These tapered rivets were adopted by the fabricator. For 1⅛-in. holes, the rivets were 1-in. in diameter from the point to within about two inches of the head, then tapering to 1⅛-in. to fill the hole. This is for the reason that a long rivet upsets from the driven end, fills the hole and plugs it so as to leave the head end with little or no upset. If the driven end is left cold or not heated so much as the head, the reverse takes place. If the middle is hot and the ends are cool, the rivet is upset at the middle. Of hundreds of long non-tapered rivets, both shop and fields, which I have examined after they were cut out, very few if any hand completely filled the holes. The shop work and design of the truss, which is the largest and heaviest ever erected for a building, was exceptionally good, and the McClintic Marshall Co. is to be congratulated on its work.

In the erection the building is riveted up complete from top to bottom for one panel at a time, as the work proceeds, the eight gangs of riveters being two panels behind the erectors. An air pressure of 100 lb. per square inch was maintained for riveting the truss, but the balance is being done with 95-lb. pressure.

The erection derricks are reeved with ⅞-in. wire rope, 13 parts to the topping lift and varying for the load lift. The topping-lift blocks are tandem six-sheave blocks designed and built by the erectors, the large sheaves being 18 in. and the small ones 16 in. in diameter. Each derrick has a 12-ft. bull wheel operated by a separate swinging engine of the steam turbine type. The double-drum hoists have 8¼ x 10-in. cylinders and four spools.

Progress averages 100 tons of steel erected per day per traveler and 3,400 rivets per eight-gang day. It is expected to complete the erection by Jan. 1, 1922. The Kelly-Atkinson Construction Co. has the contract for this erection, and the work is in charge of the writer as engineer for that company.

House Ownership in the U. S.

The number of homes in the United States as enumerated by the census of 1920, was 24,351,676. Of these 54.4 per cent were rented, 28.2 per cent were owned by the occupants and were free from encumbrances, while 17.5 per cent were owned but mortgaged.

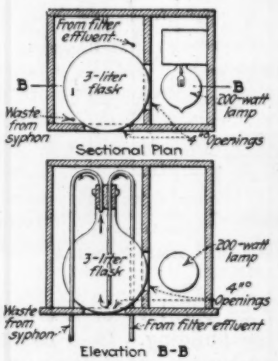
Loss of Head as a Criterion for Washing Filters

Arbitrary Time Interval Between Washes Replaced by a Rational Standard Obtained by a New Turbidity Detector

By James W. Armstrong
Filtration Engineer, Montebello Filters, Baltimore, Md.

During the course of the last six years many things have happened at the Montebello filter plant to upset the ordinary accepted theory of things. One of these is the value of loss of head as a criterion for washing filters. Turbidity has replaced loss of head, and a new turbidity detector has been developed.

It was noticed that, with water coming to the plant under normal conditions and with filters being washed on an 8-ft. loss of head, the lengths of run would vary from about 48 to more than 100 hours with apparently good results. Occasions arose when the combined filter effluent would show cloudy water when the loss of head was as low as 3 or 4 ft. At such times loss of head was valueless as an indication of the proper time for washing filters, and an arbitrary method of washing based on the time of service was adopted.



TURBIDITY DETECTOR USED AT BALTIMORE FILTERS

As a means of determining the clarity of the combined filter effluent, a device similar to that used at several other plants was installed at the outlet of the filtered water basins. It consisted of a 60-watt electric lamp, with waterproof connections, which was lowered to the bottom of the basin. A piece of opalite glass was anchored on the floor under the lamp for the purpose of reflecting the light. This device enabled the filter attendant to detect the slightest turbidity in the water when it was from 6 to 8 ft. deep.

For judging the quality of the water leaving the plant it proved very helpful, but with a water not up to standard it failed to point to the guilty filter. It was thought that if such a device could be provided for each of the filters, it would establish a rational instead of an arbitrary standard for indicating the proper time for washing filters.

In at attempt to prove the practicability of the plan, several filters were equipped with 3-in. steel tubes, which were placed in the pipe gallery and provided with an inlet pipe at the bottom and an overflow pipe 5 ft. higher up. The filter effluent was kept flowing slowly through the tube and a light was placed under its glass bottom to permit observation of the water. The lighting conditions were changed from time to time, but the experiment was not a success because the small diameter of the tube interfered with the proper distribution of light, to such an extent that slight differences in turbidity could not be distinguished.

Next, experiments were made with what is virtually a Tyndall meter. A 3-liter flask was equipped with copper tubes for siphoning the filter effluent through it. The flask was set on one of the operating tables and beside it was a 200-watt electric lamp. Both were cov-

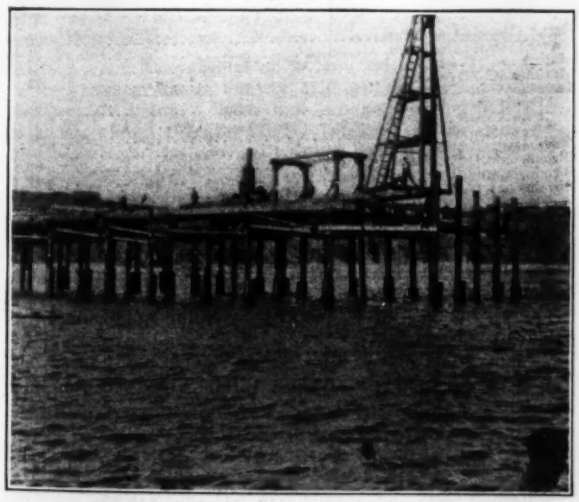
ered with a black wooden box with a partition separating the lamp from the flask. A small round hole in the partition permitted the light rays to pass through the flask at right angles to the line of sight, which was obtained through a similar round hole in the front of the box. At first some trouble was experienced with air, but after that had been overcome, even a very slight turbidity could be detected in the water. The results were so satisfactory that sixteen filters were equipped with similar devices.

So far, the personal judgment of the observer is the only means devised for comparing the effluent of one filter with another, and as this cannot be reported in definite terms, the objection might be raised against the appartus that it affords no definite standard of comparison. An attendant can, however, soon learn to detect the slightest difference in filter performance, and as this turbidity detector is more satisfactory than a loss-of-head gage, the remaining 16 filters are soon to be equipped with them.

Concrete Armored Piles in Wharf At Port Orford, Ore.

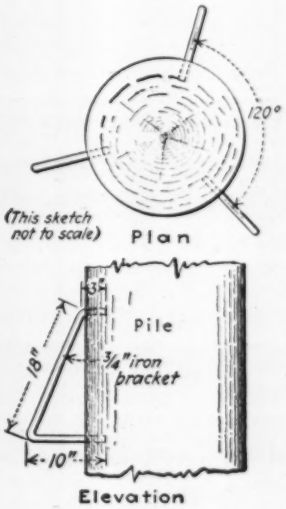
Metal Pipe Driven To Serve as Forms—Brackets in Piles Insure Desired Thickness of Concrete at Ground Line

A SMALL wharf recently constructed at Port Orford, Ore., is supported on piles which are protected from teredo action by a coating of concrete placed in forms of corrugated iron pipe slipped down over the pile. About 125 fir piles were driven in bents 20 ft. apart and protected in this way. Features of the work were the method of centering the piles in the form at the ground line and the follower used for driving the pipes. The need for some form of pile protection was decided upon after it had been found that on account of borer action unprotected piles in this port required renewal after about one year of service.



PORT ORFORD WHARF WITH PILE CASINGS IN PLACE
Concrete not yet poured or piles centered in casings

Before starting the work of pile driving, small dynamite charges were used to blast potholes at the point where each pile was to be located. After driving a pile to refusal the driver would back away while a section of 2-ft., 14-gage corrugated pipe, previously cut to desired length, was slipped over the pile and allowed to slide down to the bottom.



ARRANGEMENT OF BRACKETS

Penetration of the Casings.—The pile driver was then moved back into place and if the weight of the 3,400-lb. hammer resting on top of the follower was not sufficient to secure the desired penetration of the corrugated pipe casing, it was given a light blow, such as would be delivered by the hammer falling not more than 1½ ft. The depth of water ranged from 16 to 30 ft. and the maximum length of casings was about 34 feet.

The casings were ordered from the factory in lengths to fit every bent. They were allowed to extend 2 to 3 ft. above high water level and as the bottom at this location apparently does not change, the casings were driven only 10 in. to 2 ft. below the ground line. Because of the potholes blasted this penetration was considered to be of considerably greater effective depth than if driven without the aid of blasting. The lower limit of teredo action in this region is reported to be about 6 in. below the ground line.

The follower with which the casings were driven consisted of a short section of the casing with timber fittings or cushions on top and bottom. The one used on the bottom was a square frame of 10 x 10-in. fir in which a groove about 1½ in. deep had been cut to fit the top of the casing below. The section of casing used as a follower had to be long enough to extend above the pile top at least the amount of the penetration desired.

Method of Centering.—To center the pile in the casing three brackets were attached to each pile before driving at a point which would be about 3 or 4 ft. above the ground line. The penetration of the piles on this job ranged from 10 to 17 ft., but the change occurred at a fairly uniform rate so the penetration could be predicted with sufficient accuracy for placing the brackets. Each bracket was made of a piece of ¾-in. iron, 31 in. long, having right-angled bends 3 in. and 10 in. respectively, from the ends. By driving the 3-in. leg into the pile with the 18-in. side of the bracket extending toward the lower end of the pile, the lower right-angle bend would be 10 in. from the pile. This was greater than the thickness of concrete desired and the 10-in. leg was accordingly driven into the pile until the projection plus half the diameter of the pile at this point was slightly less than half the diameter of the casing.

The three brackets were spaced around the pile about 120 deg. apart. The upper end of the 18-in. side of the bracket was thus flush with the surface of the pile and sloped away from it in a downward direction. The brackets so arranged would guide the casing into place and hold it centered around the pile while the concrete was setting.

Concrete was mixed in the proportion of 1:2:3 and placed by means of tremies. No reinforcing was used.

The casings were dipped in asphalt before leaving the factory and although joints were not water-tight the leakage was so small that its effect on the concrete was disregarded. The piles varied from 10 to 14 in. in diameter at the larger ends and 24-in. casing was used for all alike.

S. P. Pierce of Sixes, Ore., under whose direction the design and construction were carried out, states that handling the tremies would have been easier if 30-in. casing had been used instead of the 24-in. Also he suggests that it would be better to make the 2 or 3 ft. of casing at the bottom plain instead of corrugated to facilitate getting the desired penetration. If this type of construction were to be used where shifting bottom was encountered, he suggested that greater penetration of the casing would be advisable.

Utilizing Gas from Sewage Sludge as Motive Power

BY JOHN D. WATSON

Engineer, Birmingham, Tome and Rea District Drainage Board, Birmingham, England.

A paper read before the Institution of Municipal and County Engineers, Birmingham, England, Nov. 12, 1921

THE ever increasing need for power on sewage-works, the present cost of fuel, the persistent demands for economy and the salvage of waste products are all influences which compel exhaustive inquiries into every possible source of power. The object of this paper is to suggest a source of power hitherto overlooked or minimized, and to describe experiments and experiences which are calculated to stimulate further inquiries into the possibilities of utilizing the marsh gas which is formed by organisms acting upon decaying vegetable and other organic substances.

When this Institution met in Birmingham two years ago, I described in some detail the intensive fermentation process adopted on the Birmingham sewage-works to render the vast quantities of sludge inoffensive without destroying its fertilizing properties, or lessening its calorific value. In that paper comparatively little was said about the gas evolved by the fermentation process beyond making reference to the marked differences between crude sewage sludge before and after it enters upon the septic or putrefactive stage. Illustrations were given to show that sludge during the digestion process is lighter than water, but what at first sight appeared to be a reversal of the law of gravitation is a delusion; it is merely an instance of solid matter being held up by gas formed in the course of the putrefactive change which takes place when organic matter is acted upon by bacteria and their enzymes. It was shown how sludge in this condition was more easily pumped than fresh sludge; friction in the process of forcing it through a cast-iron main five miles in length was lessened. When the main referred to was first laid difficulties were anticipated which were not realized in practice; it was assumed, therefore, that the comparatively frictionless propulsion of solids through the main was probably due to the reduced density of sludge and to an innumerable number of gas bubbles acting like so many ball bearings between particles of solids thus tending to reduce the viscosity of the sludge.

It is now proposed to refer to the nature and power of this gas, and to give illustrations of what it can be made to do when under control, for it is possible to harness this veritable will-o'-th'-wisp if the conditions are understood and taken advantage of in a scientific manner.

More than a quarter of a century ago gas generated in Cameron's covered septic tank was drawn off and employed in the Exeter sewage works. In the beginning of 1920, I visited the Matunga Leper Asylum at Bombay, where a small engine had been driven by sewage gas by Mr. James as far back as 1907. In both these cases the gas was generated in closed septic tanks which favored the cultivation of the anaerobic organisms, and at Bombay the climate was specially favorable. But the work done more recently by Mr. Walshaw at Parramatta in Australia, under what he terms aerobic conditions, are much more remarkable; indeed, it was knowledge of this case coming immediately after his Indian experiences which induced me to try whether it was possible to obtain equally successful results in the changeable, unreliable climate of England

The opportunity for making a test at Cole Hall presented itself to me and the Birmingham Drainage Board, which had some years previously approved plans for driving the pump there by a suction gas engine, consented to the scheme being varied to admit of a sewage gas plant being substituted for the suction gas plant. Very little alteration was required to meet the changed conditions and little expense was incurred in defraying the cost of the experiment.

The plant is designed to give 25 B. hp. for a working period of 6 hr. per day. It comprises a 34 (max.) hp. horizontal gas engine of the ordinary suction type, a 5-in. centrifugal "unchokable" sludge pump, a small sludge pump well, and a sludge digestion tank in two sections. There yet remains to be erected a small gasholder, without which it is impossible to keep the engine running for more than 1½ to 2 hr. consecutively.

The 9-in. exhaust pipes for the engine pass through the digestion or generating tanks with the object of imparting heat to the sludge and so promoting fermentation, thus benefiting from the experience gained at Saltley where for a dozen years it has been customary to inject live steam into the sludge during extremely cold weather. Provision is made for effecting an occasional disturbance of the mass by injecting compressed air, but this is not altogether satisfactory, as it interferes to a certain extent with the regulation of the mixtures supplied to the engine, and arrangements will shortly be made to effect the desired disturbance by means of compressed gas drawn from the top of the sludge digestion tanks. This will also serve to mix the fresh charges of sludge.

TABLE I. PERCENTAGE VOLUME OF MARSH GAS IN SEPTIC SEWAGES

	Per Cent
Exeter (Donald Cameron)	20.13
Exeter (Donald Cameron)	24.4
Matunga (C. C. James)	21.25
Matunga (C. C. James)	23.9
Lawrence (Mass. State Board of Health):	
Septic Tank A	79.0
Septic Tank B	37.5
Septic Tank F	75.9
Parramatta (Septic Gas Co., of Australia)	60.0
Birmingham (J. D. Watson), Aug., 1921	60.1
Birmingham (J. D. Watson), Sept., 1921	77.0
Birmingham (J. D. Watson), Nov., 1921	67.5

The principal constituents of sewage gas are methane (CH_4) hydrogen (H) nitrogen (N) and carbon dioxide (CO_2) and it is upon the marsh gas or methane we chiefly rely.

Table I gives the percentage by volume of marsh gas found in various septic sewages in England, America, Australia and India and Table II gives analyses of the sewage gas at Birmingham in September and October.

TABLE II. ANALYSIS OF BIRMINGHAM SEPTIC TANK GAS, SEPTEMBER AND NOVEMBER, 1921

	Per Cent	Per Cent
Carbon dioxide CO_2	18.1	25.2
Hydro carbon HC	0.2	
Oxygen O_2	0.4	0.3
Carbon monoxide CO	1.1	
Methane CH_4	77.0	67.5
Ethane C_2H_6	trace	2.8
Nitrogen N_2	3.2	4.2
	100.0	100.0
B.t.u.'s per cubic foot	700	650

Results from such a wide selection of places in different parts of the world seem to indicate that marsh gas is evolved from organic matter as readily in one climate as in another, but in fact it is not so, and the results of the analyses show the need for more definite information and

caution in their application. Results obtained by Mr. Rhead, chief chemist to the Birmingham Gas Department, in his analyses of the Cole Hall gas emphase this statement.

The amount of gas from the total volume of available sludge which can be relied upon at Cole Hall is greater than the power demand there, but it is certain to vary with the seasons, and it is as sure to vary with the age, the volume, and the condition of the organic matter in the sludge. Steps are therefore being taken to investigate the facts with a view to preparing graphs which will show (1) the volume of gas to be obtained from a given volume of average sludge (10 per cent dry solid matter) in a given time (2) and one which will show at what time the sludge gives off the maximum quantity of gas, and what time is needed to change that maximum into a minimum.

Probably the majority of the results given in Table I were obtained from septic sewage, but I think it is from sludge and not from liquid sewage that gas can be obtained in sufficient volume to render its use economical. This statement is contrary to that put forward by Australian observers, who claim that the best results can be obtained from aerobic treatment of sewage.

Up till now the sludge available at Cole Hall has been very watery (containing only 3 per cent dry solid matter.) This was owing to the fact that the supply was temporarily

TABLE III. ANNUAL COST OF SEWAGE GAS PLANT COMPARED WITH STANDARD SUCTION GAS PLANT

Duty—25 B.hp. for daily period of 6 hr. The cost of gas engine, engine house, pump and pump well being common to both plants, is ignored in the comparison. The cost of labor, lubrication, and repairs is also approximately equal, and does not appear in the comparison.

Suction Gas Plant:						
Capital cost, £300.						
Annual charge on £300@10%.....	£30	0	0			
30 tons of anthracite at £3 per ton (allowing 1½ lb. per B. hp.hr.).....	91	10	0			
				121	10	0
Sewage Gas Plant:*						
Generating tanks, with complete equipment of fittings, and all pipe work £600 at 7% (repayable in 25 yr.), £42.						
Provision for gasholder £500 at 10% (repayable in 14 yr.), £50.....				92	0	0
Net annual saving in favor of sewage gas plant.....				£29	10	0

* Probably the sewage gas plant can be cheapened when more exact knowledge of the principles of working have been obtained.

dependent upon the ability of a land irrigation pipe laid on a very flat grade to convey it from the outfall works to the engine house. By a new sludge main which will soon be completed a denser sludge (at least 10 per cent dry solid matter) will be conveyed to the tanks, thus reducing the volume of water which has hitherto entered the tanks, persistently lowering the temperature of the mass and taking up space which should be occupied by organic matter which is capable of yielding gas. With a more concentrated sludge, it is evident that the gas forming material temporarily confined in the limited space should produce a greatly increased volume of gas (a matter of prime importance until a gasholder is provided as part of the installation), for it is necessary to impound surplus gas to be drawn upon when the demand by the engine exceeds the volume available in the digestion or generating tank.

Notwithstanding existing weaknesses in the experimental plant, the fact remains that the engine has worked successfully and has given out the power required to drive the pump.

At Cole Hall, where the gas engine has been installed, the method of disposing of sludge has hitherto been quite different from that obtaining in the main works in the Tame Valley. At the latter works the sludge is subjected to the fermentation process, but at Cole Hall farmers buy it for agricultural purposes, and it is obvious that so long as it can be got rid of in this, the most satisfactory way, there is no need to employ intensive fermentation. At Cole Hall, therefore, only sludge required to give off gas for power will be subjected to fermentation, and judging from the limited experience available it is estimated that about two tons of wet sludge (10 per cent dry solid matter) per day will be required to provide an explosive gas capable of generating 25 B.h.p. for a working period of 6 hr. per day. The amount of available sludge at Cole Hall is approximately 80 tons per day (10 per cent dry solid matter).

The sludge after it has been discarded will probably be freer of fat and grease than it was before fermentation, and to that extent it will be more valuable to farmers than it was in its initial stage; moreover it will still retain about 2 per cent of nitrogen after it has given off its methane, so that its fertilizing properties are not thereby exhausted, if indeed they are materially lessened.

Before emphasizing the fact that we have in marsh gas a useful power for driving an internal combustion engine, and that we have great volumes of this gas in sewage sludge, there is the all important question—is it economical to use it?

It is obviously the business of the engineer to determine this, and he will require to take into account comparative costs of fuels, probable fluctuations in prices, the location of the works, transport facilities, effect of strikes on the supply of fuel, etc.

It was originally intended to put in a suction gas plant, and although it is hardly time to make a comparison which can be relied upon, the figures given in Table III are interesting and may be helpful.

The following notes should be pondered by those who think of developing the Cole Hall experiment. Success in designing an installation is dependent on accurate information regarding (a) the percentage of sludge (dry solid matter) which is capable of gasification, (b) the rate of evolution of the gas at various temperatures, and (c) the proportion of methane in the composition of the gas.

(a) Sludge, like sewage, is of diverse composition; much of its value as a gas producing substance depends upon the efficiency of the grit chambers and the amount of organic matter left in the sludge. There can be no doubt that the gas comes from the decomposition of organic matter, and an inordinate proportion of inorganic matter would be a distinct hindrance; so would large doses of tarry and oily substances mixed up with the sludge lessen, if they did not entirely inhibit, the gas producing power of the putrefactive organisms.

Again, a modern sewage system is designed to convey to a place of disposal almost every form of trade as well as domestic wastes, and water is the vehicle by which it is conveyed. That the fouled water contains organic matter is true, but obviously it is the sludge which is brought down with the water that contains the material from which gas is produced, so that the less liquid there is in sludge which is set aside for gasification the better. This, however, leads to a position where one may go wrong very readily. It is most difficult to obtain fresh sludge which contains more than 10 per cent of dry solid matter, but the author has found to his cost that you may keep such sludge in a tank for a whole year without its undergoing the putrefactive change so essential to the production of gas. It is not enough, therefore, to set aside great volumes of organic matter—that matter must be introduced into a tank which has already been inoculated by the right organism, and it should not be introduced so rapidly that the organisms are smothered.

On the Saltley works, where sludge is treated in order to deprive it of smell and its emulsive character, it is found to be advisable to mix the fresh material with about 20 per cent of "ripe" sludge when it is first transferred into a digestion tank; it is desirable also to maintain its temperature as high as possible with the view of providing those conditions which favor putrefactive change. Probably Dr. Travis' hydrolytic tank was the direct result of the desirability of doing this work efficiently. Dr. Imhoff, the German engineer, improved on Travis' tank and boomed it in America, where it has proved to be a very efficient instrument for separating fresh sewage from sludge which is kept designedly for months in order to convert it into an inodorous mass. The Birmingham method is better adapted to local circumstances, but the results are similar except that the Birmingham method is so arranged that it is possible to isolate sudden rushes of anti-septic liquor, a matter of considerable importance at times.

Another line of investigation essential to ascertaining the

volume of gas which may be evolved from a given quantity of sludge is the influence of agitation. We know as a fact that disturbance of the mass is beneficial, but we are ignorant of the extent to which it should be carried. When a silt tank at Saltley fails to ferment, its contents are passed through the pump and distributed amongst what are termed ripe or healthy tanks. The breaking up of the sludge as it passes through the direct-acting pumps effects a considerable change, but this side of the question requires further investigation, and what has already been done in Australia in this regard should not be overlooked.

(b) Temperature plays a very important part in the rate of evolution of gas, and the volume extracted from a given quantity of sludge. In a sewerage district of 115 sq.mi. it takes so long for some sewage to travel to the outfall that it is mildly septic before it arrives there, but when the district is small the liquid portion of the sewage is for the time being almost free of putrefactive tendencies and will probably remain so throughout its treatment. The sludge, too, may take longer to septicize but if treated under anaerobic conditions should be converted into gas in the quickest and most favorable way. We do not know the temperature at which the organisms will cease to act altogether, nor the temperature at which they will act most efficiently; investigation is required, therefore, if we would ascertain this one of the essential factors of the problem

TABLE IV. DATA REGARDING BIRMINGHAM SEWAGE-GAS INSTALLATION

Ordinary suction gas engine	34 (max.) B.hp.
Duty of engine	25 B.hp. for 6 hr. per day.
Quantity of gas consumed per hp.	20 cu.ft.
Estimated quantity of gas required per day	3,000 cu.ft.
Maximum duty of "unchokable" pump	450 imp. gal. per min. against a head of 36 ft., at about 1200 r.p.m.
Rising main	12 in. diameter.
Sludge capacity of generating tank	80 cu.yd.
Proposed capacity of gasholder	2,000 cu.ft.
Aevrage proportion of methane in gas	60 to 77%.

The composition of the sludge also should be considered when endeavoring to find out the rate of evolution of gas. Domestic sewage *per se* is probably better than any other for gas production, and some sewages, so far from containing putrefactive organisms, possess qualities which sterilize those that emanate from domestic sources. Rushes of acid water, for example, affect whatever they come in contact with. One of the Birmingham outfalls is so bad in this respect that in five months a new-cast iron centrifugal pump impeller is pitted all over and the extremities worn to fine points.

(c) The analytical constituents of the gas emanating from the available sewage sludge should be determined with accuracy. The figures in our possession are limited; so far they lead us to say that the gas contains from 60 to 77 per cent of methane, but with frequent determinations taken over a longer period it will be possible to give a more reliable figure.

Table IV gives some of the main figures regarding the sewage-gas installation.

The following observations on the working of the plant between Sept. 6 and Nov. 3, 1921, although varying in some respects with our original estimate, are of considerable importance: Total amount of dry solid matter passed through tanks, 4 long tons; average period of retention, 6.4 weeks; average percentage of dry solid matter in wet sludge, 3; (the plant now contains sludge having a proportion of 10 per cent dry solid matter); estimated amount of gas consumed by engine, 25,000 cubic feet.

The total gas yield is, of course, in excess of this amount, but it will only be possible to measure it when a gasholder is available. Under present circumstances a considerable quantity of gas is lost each time a recharge of sludge is made. A certain amount of gas has also been lost in making tests and minor alterations. A gas production of 25,000 cu.ft. from four long tons dry solid matter is equivalent to 1 cu.ft. gas from 0.36 lb. dry solid matter, or a gasification of 18 per cent of the total dry solid matter. This is only 60 per cent the amount of sludge gasified in open tanks in the Tame Valley.

In conclusion, it is worthy of remark that the fact which has influenced the author more than any other in following up this experiment consists in this: that 400,000 long tons of wet sludge containing 27,000 long tons of dry solid matter is dealt with on the main works at Birmingham every year, and that as much as 9,000 long tons of dry solid matter is gasified. This is equivalent to 320,000,000 cu.ft.

Rectangular Enginehouse with Interior Turntable

Two Canadian Railways Adopt Novel Plan To Reduce Winter Trouble at Terminal by Putting Turntable Under Cover

A TURNTABLE placed inside a rectangular enginehouse and serving sixteen radial tracks with repair pits is the very unusual arrangement adopted at the new engine terminal of the Canadian National Railways at Hornepayne, Ont. Its purpose is to facilitate work under severe conditions due to prolonged low temperatures reaching 60 deg. F. below zero, when turntable work is very hard on the men. It also eliminates snow troubles, although at this place the snowfall is not very heavy as a rule and owing to the extreme cold the snow is usually fine and hard, so that it is not difficult to handle. But at many points snow troubles would make an inclosed turntable very desirable. The general plan is shown in Fig. 1.

This unusual arrangement was adapted from a similar enginehouse built in 1912 at Sault Ste. Marie, Ont.,

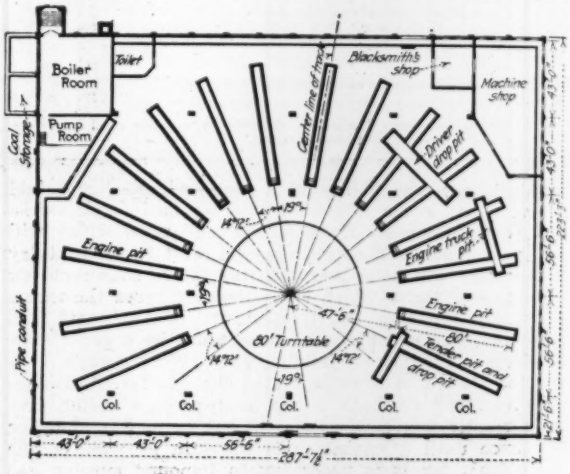


FIG.1. ENGINEHOUSE WITH INTERIOR TURNTABLE AT HORNEPAYNE, CANADIAN NATIONAL RAILWAYS

for the Algoma Central & Hudson Bay Ry. and designed jointly by R. S. McCormick, chief engineer of the railway, and P. L. Battey, then chief engineer of the Arnold Co., Chicago. In the older building, Fig. 2, 179 x 266 ft., there is a two-track entrance and two tracks extend through the machine-shop at the rear. Steel roof trusses are carried by columns spaced 44 ft. in each direction, except that at the turntable there is a span of 88 ft. A special feature is that the repair pits are served by a circular industrial track of 24 in. gage, this line being connected by turntables with lateral tracks to the drop pits and into the machine shop.

Where the rectangular form of enginehouse has been adopted by American railways it has been the usual practice to have a layout of parallel tracks served by a

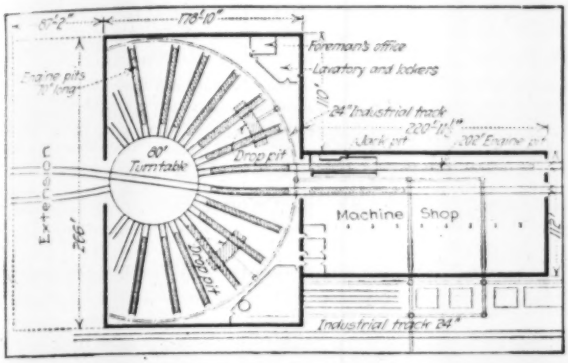


FIG. 2. ENGINEHOUSE WITH INTERIOR TURNTABLE ON ALGOMA CENTRAL & HUDSON BAY RY.

transfer table or by a ladder track on the outside, as in the enginehouse of the Denver & Rio Grande R.R. at Soldier Summit, described in *Engineering News-Record* of May 27 and June 10, 1920, pp. 1069 and 1159. Rectangular structures with inclosed turntables have been used in England. An enginehouse of this type on the Great Western Ry., 440 x 360 ft. has four 65-ft. turntables, each serving 28 radial tracks of different lengths, six of these tracks forming entrances (see *Engineering News*, June 13, 1907, p. 642).

From the plan, Fig. 1, it will be seen that the Hornepayne enginehouse is 287½ x 223¼ ft., with two entrance tracks leading to a turntable near the front of the building, and with another track passing out at the rear. This arrangement provides for a future extension, the turntable being then at the center of the building. This 80-ft turntable is of the center bearing type, operated by a compressed-air tractor which rides on the circle rail. The walls of the building are of brick on concrete foundations which are carried to a depth of 7 ft. A water-bearing mixture of sand and clay makes a top soil difficult to deal with, and quicksand is found at 4 ft. below the foundations. A considerable proportion of the wall area is of steel sash and the track entrances have wooden swinging doors. A cinder floor is laid, except that concrete is placed in the machine shop and boiler room.

Steel roof trusses form a rectangular framing with spans of 21½ to 56½ ft., except that at the center the span is 113 ft. in both directions in order to clear the turntable, as shown in Figs. 1 and 3. The interior columns, built up of H-beams and plates, rest on concrete pedestals whose tops are 11 in. above base of rail. Three monitors 8 ft. high and 22 ft. wide, extending the full length of the building, have their sides formed of steel sash with ventilating panels. This roof is designed for a total load of 10 lb. per sq.ft. and has 3-in. plank sheathing covered with tar and gravel.

Radial tracks laid with 80-lb. rails are spaced at an angle of 14 deg. 12 min. between center lines, except that where columns intervene the angle is increased to 19 deg. All the repair pits are 80 ft. long. Two are connected by a transverse drop pit for handling driving wheels and two others have a similar but smaller pit for handling truck wheels. One of the end pits is reserved for tenders and has a lateral drop pit for handling the truck wheels. A hot water plant for washing out boilers is provided, and all pits have convenient connections to pipe lines for steam, compressed air and hot and cold water. Electric lighting is provided, with portable drop lights for use in the pits. Wood smokejacks are used, of a standard type designed and built by the railway. It is stated that none of them have ever caught fire, as they are protected by fire-resistant paint and soon accumulate a protective coating of soot. These smokejacks are placed 119½ ft. from the center of the

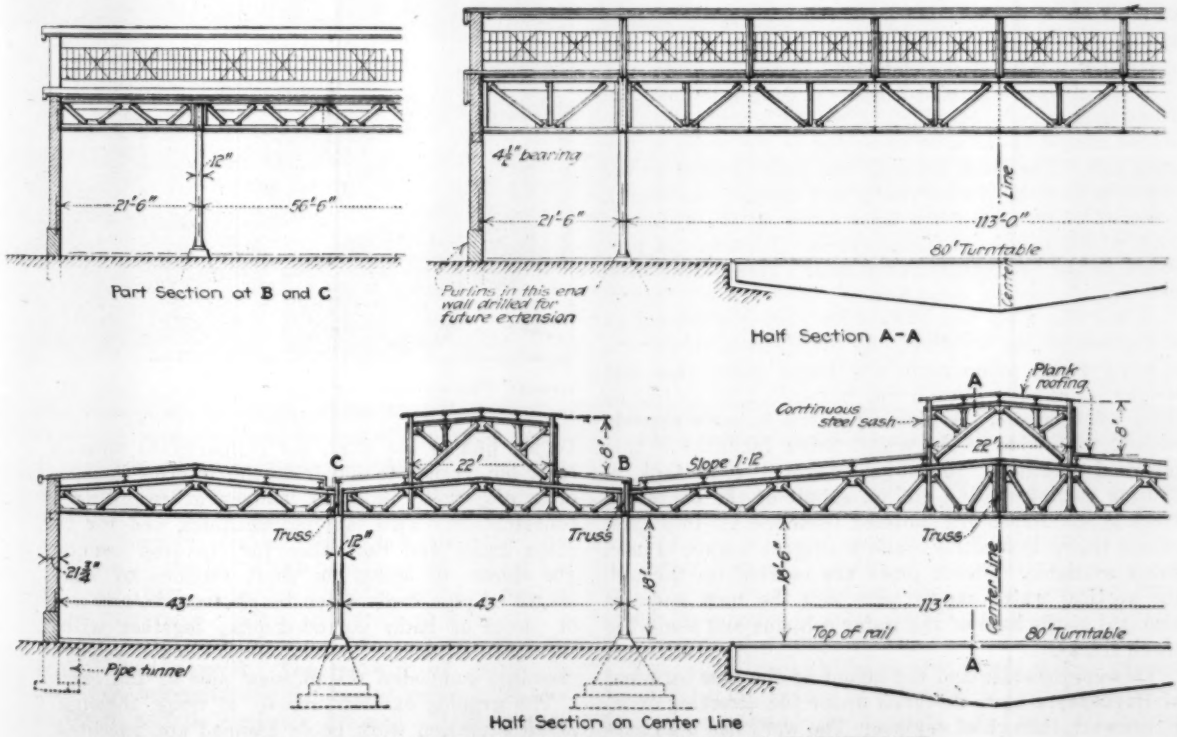


FIG. 3. STEEL ROOF FRAMING OF RECTANGULAR ENGINEHOUSE

turntable. Six exhaust ventilators with 36-in. openings are placed over the turntable at 30 ft. from its center.

Concrete repair pits are employed, these pits and the turntable pit being all drained to a sewer. No crane is provided, but all raising of the engines is done by jacks. For this purpose a rather unusual floor and track construction is used, as shown in Fig. 4. Each pit wall is covered with transverse timbers 6 x 10-in. laid close together; these timbers are 3 ft. 3 in. long, with one end projecting 5 in. over the pit and the other end spiked to a 6 x 10-in. timber embedded in the soil. At the pilot end of the pit there is on each side a jacking block of concrete instead of the wooden blocks, which arrangement has been found very satisfactory. Track

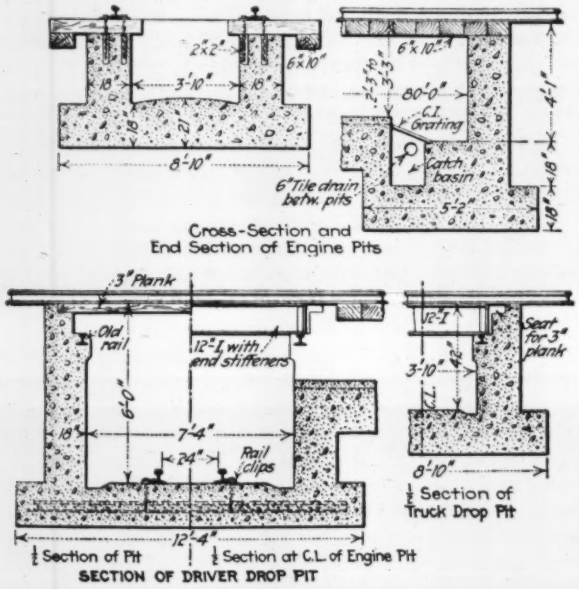


FIG. 4. ENGINE REPAIR PITS AND DROP PITS

rails of 80-lb. per yd. laid upon the transverse timbers are secured by clamps with long drift bolts driven into vertical 2 x 2-in. sticks embedded in the concrete.

Track rails are carried across the drop pits on 12-in. I-beams, the ends of which, fitted with stiffeners, are seated on old 56-lb. rails embedded in the walls of the drop pits. The large drop pit has rails secured to the concrete floor by anchor bolts and clamps, forming a track of 24 in. gage for a truck carrying the hydraulic jack which handles driving wheels. No track is provided in the two smaller drop pits. These three drop pits are covered by loose 3-in. planks when not in use.

A machine shop and blacksmith shop are located in one corner of the building. At the opposite corner are a toilet room, pump room and boiler room, this last having an outside 150-ton coal bin served by an incline track on a trestle. A pipe conduit 3 ft. wide extends around the inside of the wall. Other facilities at this terminal include a 70,000-gal. elevated steel tank, a 200-ton coaling station and an ashpit of the depressed track type. Ashes are shoveled from the pit into cars, except that a locomotive crane with grab bucket is used when available. Steam pipes are carried up through the vertical water supply pipe into the tank and are also laid at the base of the water columns and along the coach tracks.

This enginehouse and the layout of the new terminal at Hornepayne were designed under the direction of A. F. Stewart, then chief engineer. The work has been carried out by railway forces under H. T. Hazen, acting chief engineer of eastern lines, Canadian National Railways; W. V. Appleton, general superintendent of rolling stock, and G. C. Briggs, architect.

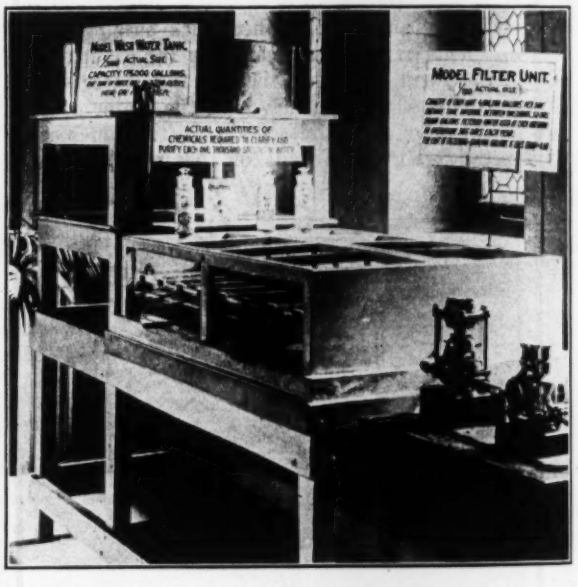
Water-Works Shares in Exhibit of St. Louis City Activities

By T. Chivvis
Engineer-in-Charge, Distribution Section, Water Division, St. Louis, Mo.

THE various city departments of St. Louis, Mo., were recently requested by the Municipal Reference Library to place on exhibition such apparatus, models, maps and photographs as would show to advantage the activities of the city. The city engineers, among many others, have responded in a manner which has attracted wide attention.

The Water Division constructed a model filter unit on a ½ scale, which was connected to the ⅜ in. supply of a bubbling fountain and drained into the bowl of this fixture. Head is supplied to the wash water by a circular copper tank supported several feet above the bed. On account of the greatly reduced depth of sand and other difficulties, no attempt was made to filter turbid water. The usual washing rate cannot be obtained on account of the restricted capacity of the bubbler drain, but with these two exceptions the model operates exactly as the real filters.

Two ⅝-in. glass-case water meters are installed in the



MODEL FILTER UNIT IN EXHIBIT OF ACTIVITIES OF CITY DEPARTMENTS OF ST. LOUIS, MO.

supply line to the filter, not primarily to measure the rate, but rather to illustrate the interior construction of a disc meter and its manner of recording water consumption. Two tapping machines, one for corporation cocks and the other for cast-iron connections, are shown in action on short sections of main. A length of pipe badly eaten by electrolysis, and a couple of pieces of badly corroded pipe, together with photographic evidence of the improvement wrought by cleaning, completed the physical side of the exhibit.

The graphic exhibits consist of maps showing proposed extension work being planned and executed.

The Probable Frequency of Given Rates of Rainfall

Average-Rate Method More Economical for Design of Public Works than Uniform-Intensity Method—Data Reviewed

By Adolph F. Meyer
Consulting Engineer, Minneapolis, Minn.

FROM time to time articles have appeared in *Engineering News-Record* and other technical magazines relating to the probable frequency with which certain rates of intense rainfall may be expected in various parts of the country. In these studies of rainfall a procedure has been adopted which leads to erroneous conclusions respecting the frequency with which given amounts of precipitation may be expected in periods of from about 30 to 120 min. Conclusions regarding the frequency of downpours of shorter duration, as a rule, are not materially affected.

My criticism is directed to the failure to consider rainfalls occurring within 50 min., for example, in determining the frequency with which 60-min. downpours of certain magnitude will probably recur. In the design of engineering works, the fact really used is the amount of rain that falls within a given time, rather than the rate of rainfall in inches per hour for that time. Most runoff formulas use the term "rate of rainfall" merely as a matter of convenience, because this is substantially equivalent to the run-off from an impervious area in cubic feet per second per acre. The rainfall rates commonly used in these formulas are derived from the amount of precipitation registered by rain gages and therefore represent *average* rates for the given time intervals. Hufeland, in his article, "Long-Time New York Rainfall as Basis for Sewer Design—II" (*Engineering News*, Sept. 7, 1916), objects to the use of these average rates and advocates the use of only those downpours having rates of uniform intensity. Notwithstanding his criticism, however, I believe the use of the "average-rate" method leads to safer and, all factors considered, more economical public works than the "uniform-intensity" method which he advocates. If we had 500 or 1,000 years of rainfall records, the latter method would be preferable. After all, "uniform intensity" is but a relative term; it represents the *average* rate for a certain time interval. The measure of uniformity adopted will determine the number of rainfall observations which will be available for use. Until a great many more intense rainfalls have been observed, averaging rates over considerable periods of time is necessary to secure a reasonable record of the frequency of given downpours. The resulting average rate of rainfall undoubtedly is as dependable a basis for a conclusion respecting the required sewer, drain or ditch capacity as the other factor entering into this problem. Hufeland further criticizes the "average-rate" method because he finds that the excessive rates, for a given time interval, are not uniformly distributed through the period of observation. Assuming the records referred to as dependable, the fact stated does not in itself form ground for criticism of the "average-rate" method, but rather of the irregular manner in which given rates of precipitation recur with respect to both time and place.

The 50-year record at New York City, in my judgment, does not form as satisfactory a basis for determining the probable frequency with which given rainfalls will recur as the combined 15- or 20-year records of considerable number of observation stations in this region.

Intense rainstorms usually cover only a few square miles. Observation stations only 5 or 10 miles apart often show as much dissimilarity in the rates of excessive precipitation during intense rainstorms as stations 50 or 100 miles apart. As there are only about two hundred Weather Bureau Stations in the United States at which continuous records of precipitation are being secured, it is apparent that only a few of the downpours which actually occur are being recorded. In some of the larger cities, municipal organizations are maintaining a number of observation stations and are thus obtaining more complete data.

It is safe to say that, taking the country as a whole, doubling the number of observation stations would double the number of records of excessive precipitation obtained in any given number of years. For the same reason, the records of several stations in one region are virtually equivalent to a longer record at a single station. One record supplements the other, making a combined record which is far more representative of the frequency with which given rates of precipitation may be expected than the records of a single station.

The extent to which the records of one station supplement those of another in the same part of the country is well illustrated by a study of Table 11 in my

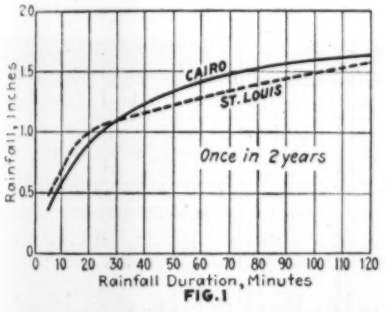


FIG. 1

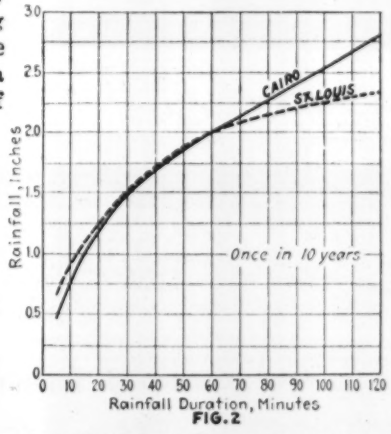


FIG. 2

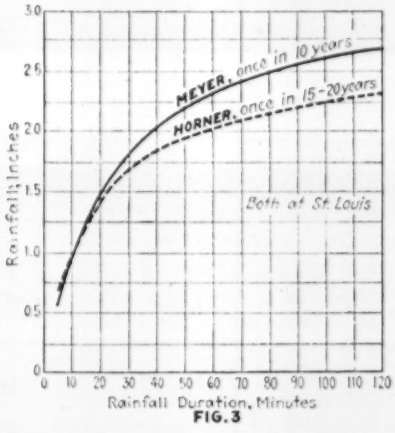


FIG. 3

FIGS. 1 AND 2. MAXIMUM RAINFALL TO BE EXPECTED AT ST. LOUIS, MO., AND CAIRO, ILL., ONCE IN TWO YEARS AND ONCE IN TEN YEARS. FIG. 3. MAXIMUM RAINFALL TO BE EXPECTED AT ST. LOUIS
Determined from records of individual stations.

"Elements of Hydrology" (John Wiley & Son, New York City) which gives a summary of 1,962 rainstorms in the United States. Stations with a disproportionate number of very excessive storms usually have a deffi-ciency of ordinary storms. Other stations that have experienced many short storms have had comparatively few long ones, and vice versa.

These same facts are brought out by the curves of Figs. 1 and 2. The data from which these curves are plotted are taken from Table 14 of my "Elements of Hydrology," which in turn is based upon the United States Weather Bureau records for the 19-year period, 1896-1914, inclusive. These curves clearly show that during the 19-year period, St. Louis, Mo., had a large number of exceptionally heavy 5-, 10- and 15-min. down-pours and a defficiency of heavy 1-hr. and 2-hr. storms. Cairo, Ill., on the other hand, had a deficiency of short downpours and an excess of storms of long duration. Cairo had a few extremely heavy long storms. At St. Louis these were lacking. Neither experience is re-presentative of the average frequency of recurrence of such storms.

The effect of estimating the probable frequency of recurrence of intense rainstorms from the records of a single station is well illus-trated by the curves of Fig. 3. The St. Louis (Mo.) standard intensity curve as given by Horner, in my judgment, shows rates which are too high for 5-min. downpours and decidedly too low for storms lasting from 45 to 120 minutes. (Run-off computa-tions for 70,000-acre storm water drainage area, St. Louis, *Eng. News*, Mar. 22, 1917, p. 470.)

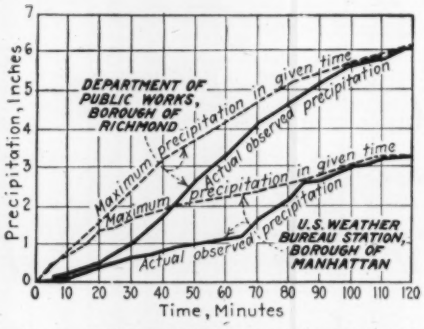

DEPARTMENT OF PUBLIC WORKS, BOROUGH OF RICHMOND
Maximum precipitation in given time
Actual observed precipitation
Maximum precipitation in given time
Actual observed precipitation
U.S. WEATHER BUREAU STATION, BOROUGH OF MANHATTAN
Precipitation, Inches
Time, Minutes

FIG. 4. DIFFERENCES IN RAINFALL AT NEAR-BY STATIONS.

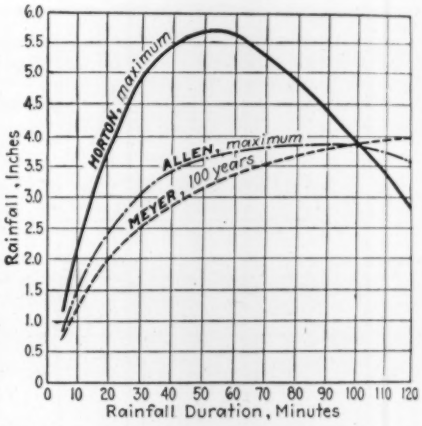


FIG. 5. MAXIMUM RAINFALL TO BE EXPECTED IN A GIVEN TIME-INTERVAL, NEW YORK CITY

During the 19-yr. period above referred to, St. Louis had four 5-min. downpours within which more than 0.6 in. of rain fell. This is equal to the number of sim-ilar downpours observed at Jacksonville, Fla., during the same period and one more than the number observed at Galveston, Texas. Or, to put it another way, at St. Louis, during the 19-yr. period, as many or more heavy 5-min. downpours occurred as at any other one of 43 stations in the United States included in the rainfall studies summarized in Table 11 of my "Elements of Hydrology." On the other hand, during the same time interval, only two storms occurred at St. Louis within which more than 1.8 in. of rain fell in one hour. This is less than fell in one hour at any one of the 18 stations located in regions of comparably heavy precipitation, for which data are given in my Table 11, previously referred to.

The difference between intense rainfalls at near-by stations is well illustrated by Fig. 4, which is a record of the New York City storm of Oct. 1, 1913, as observed in the boroughs of Richmond and Manhattan. There is practically no similarity between coincident rates of rainfall at these two stations, only five miles apart.

Assuming now that for most purposes engineers will continue to use the "average-rate" method as against the "uniform-intensity" method in the analysis of rain-fall records, I contend that if a downpour ends in 25 min., for example, the amount of rain which fell in that time should also be used in determining the average rate of rainfall for 30 min., etc. A mere statement of the case would appear to carry conviction with it. It is not apparent that there is any material difference between the effect on a sewerage or drainage system of a storm lasting 60 min., for example, during which there is an interval of very light rainfall for 10 min., and another storm within which the same amount of rain falls during 50 continuous minutes.

As an illustration of the inconsistency of grouping storms exclusively by duration in minutes rather than by amount of precipitation in inches, the storm at Buffalo, New York, March 20, 1897, may be cited. Dur-ing this storm, 0.79 in. of rain fell in 5 min. This amount of precipitation was equal to a 10-min. down-pour to be expected only once in about 15 yr. There-fore, in determining the frequency of given rainfalls in Buffalo, this storm should clearly be considered also as a 10-min. storm, even though the rain all fell within 5 minutes.

On Aug. 20, 1901, 1.77 in. of rain fell at Cleveland, Ohio, in 20 min. During the next 5 min., only 0.01 in. fell, or 1.78 in. in 25 min. This storm did not last 30 min.; nevertheless, 1.78 in. may be expected at Cleveland in 30 minutes only once in about 25 years.

Another storm of this character is that of Aug. 12, 1910, at Duluth, Minn., when 1.38 in. fell in 20 min. and 0.02 in. during the next 5 min. Although this storm lasted only 25 min., yet the amount of rain which fell is to be expected in 30 min. only once in about 12 yr. at Duluth.

Another illustration is the 20-min. storm of Sept. 30, 1902, at Indianapolis, Ind., when 1.08 in. fell in 10 min., and only 0.01 in. in each of the succeeding 5-min. periods. There is no more reason for including this storm among the 15- and 20-min. downpours because 0.01 in. fell during each of the last two 5-min. intervals than if the storm had ended completely in 10 min-utes.

Hundreds of examples of this kind could be cited. It is not at all unusual for the rate of rainfall to become very small just before the end of the storm. For this reason, it is just as logical to consider a 45-min. down-pour as a 60-min. storm as if a few hundredths of an inch of rain had fallen during the last 15 min. The basis for grouping should be the amount of precipita-tion; and the average rate of rainfall to which this

amount is equivalent should receive consideration for all time intervals within which it appears excessive.

The amount of rain that fell during most of the 100 typical intense rainstorms for which detailed data are given in Table 12 of my "Elements of Hydrology" (pp. 161 to 172), was equivalent to excessive rainfall rates over time intervals considerably longer than the actual duration of the storm. Some of these rainstorms yielded very little precipitation at the beginning of the storm, others near the middle of the storm, and still others near the end. The determination and use of intense rainfall rates for time intervals beyond the actual duration of the storm is but a reasonable interpretation and extension of the "average-rate" method of analysis.

How illogical it is to group downpours only with respect to time is well illustrated by Allen's Table No. 1, in "The Prediction of Probable Rainfall Intensities," *Engineering News-Record*, April 7, 1921, p. 588. Allen has no record of rainfall exceeding 1½ in. per hour for 120 min. (equivalent to 3 in. of rainfall) even though 3.14 in. actually fell at the Central Park Observatory in New York in 100 min. on Oct. 1, 1913; 3.60 in. fell in 80 min. on Sept. 4, 1913, and 3.02 in. fell in 60 min. on July 28, 1902.

A similar error appears in Horton's Table No. 3, in his article "Some Broader Aspects of Rain Intensities in Relation to Storm Sewer Design," published in *Municipal and County Engineering*, June and July, 1919. According to this table, a rate of 1.33 in. per hour for 120 min. or 2.66 in. of rain, is the maximum to be expected in New York City once every 45 yr. Nevertheless, the same table shows that 3.40 in. of rain is to be expected within one hour once every 45 yr. It is not conceivable that a rainfall of 3.40 in. in one hour may be totally disregarded when estimating the probable frequency of 2-hr. rainfalls. The fact that once during the period of record 3.40 in. of rain fell in 60 min. is no good reason for assuming that the next time a similar storm passes over this territory the same amount of rain may not be distributed over 80, 100 or 120 min. As a matter of fact, 3.60 in. did actually fall in 80 min. during this same storm.

Hufeland's Table II, (*Engineering News*, Aug. 31, 1916, p. 396) is similarly in error. This table shows only eight storms in New York City of 120 min. duration giving more than 2 in. precipitation, yet there was one storm lasting 100 min. during which 3.14 in. fell; two other storms lasting 80 min., which yielded 2.94 in. and 3.60 in. each, and two storms of 60 min. duration, which yielded 2.66 in. and 3.02 in. each. In other words, the record shows that 2 in. of precipitation may be expected in 120 min. once in about three years instead of once in nearly six years, as given in Hufeland's table.

In order to clarify this matter further, Fig. 5 has been prepared. The curve labeled "Horton-Maximum" is plotted from data given in Horton's paper, *Municipal and County Engineering*, July, 1919; and that labeled "Allen-Maximum" is plotted from Allen's paper in *Engineering News-Record*, April 7, 1921, both previously mentioned. The curve labeled "Meyer-100 yrs." is plotted from the weighted average of data given in Table 15 of my "Elements of Hydrology." New York City is in "Group 2" (p. 151, "Elements of Hydrology") but lies so near the borderline of this group of stations that the data in Table 15 for Group 2 are given a weight of 2, and those for Group 3 are given a weight of 1, in computing points for the "Meyer-100 yrs." curve.

It seems self-evident that the longer the time interval, the greater the amount of precipitation which may be expected with given frequency. It would not appear to require any argument to disprove the contention that 5.75 in. of rain may be expected in New York City in one hour as frequently as 3 in. may be expected in two hours.

Breakwaters of Three Types in One Lake Harbor

Rubble Mounds, Concrete Caissons and Rock Filled Pile Cribs for U. S. Naval Station at Great Lakes, Ill.

THREE types of breakwater construction are to be used for the protection of the new harbor for the U. S. Naval Training Station at Great Lakes, Ill., thus affording an interesting comparison of respective costs under similar conditions. These three types are as follows: (1) Rock fill between two lines of closely driven round piles, with a heavy concrete cap or superstructure poured in place; (2) stone rubble mound; (3) hollow concrete caissons sunk on a bed of broken stone, filled with stone and capped with concrete poured in place. The first type will be used in water from 4 to 14 ft. deep; the others will be in depths of 14 to 21

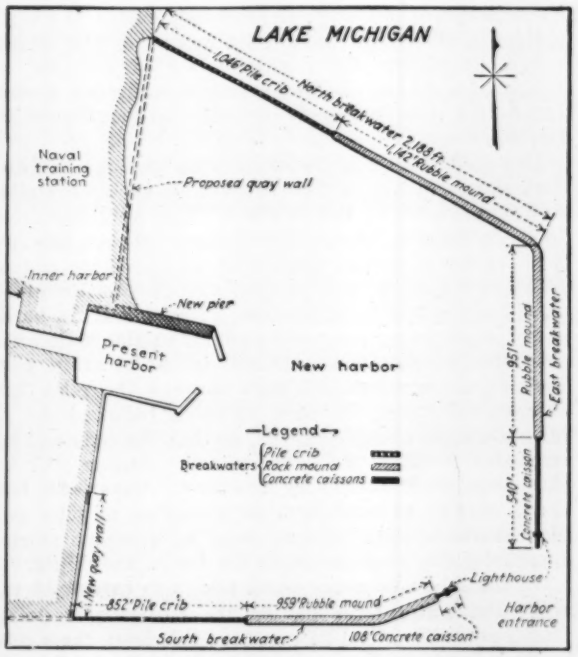


FIG. 1. BREAKWATERS OF DIFFERENT TYPES FORM LAKE HARBOR

ft. A plan of the harbor, showing the positions of the different types of breakwater which are to be built, is given in Fig. 1.

Reasons for this combination of breakwater types at one harbor may be summarized as follows from a statement furnished by the engineers:

A. For shallow water, the rock-filled pile crib construction was considered to be the cheapest and to serve the purpose adequately, since there will be no heavy seas in such shallow depths. Further, experience indicates that these depths will be reduced by shoaling

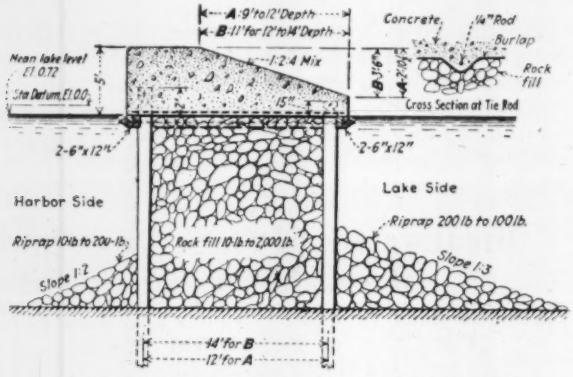


FIG. 2. PILE AND ROCK-FILL BREAKWATER

along the breakwater, particularly on the north side of the harbor.

B. For deep water, the high cost of timber made rock-filled crib construction prohibitive. The rough stone rubble mound has been found sufficient on the lakes in breaking up the waves and not allowing the passage of solid volumes of water such as would be carried over a smooth-faced breakwater. As a concrete caisson breakwater presents a smooth face to wave action is was not considered so efficient as the rubble mound.

C. For the harbor entrance, two factors governed the selection of concrete caisson construction: (1) With their nearly vertical sides they permit of the widest navigable opening for a given width of entrance, as compared with the slope of a rock mound; (2) a solid foundation was required for the lighthouses which mark the entrance.

Pile and Rock Fill Breakwater—For this construction, shown in Fig. 2, two rows of closely driven piles will retain a fill of loose rock in sizes weighing from 10 lb. to 2,000 lb. each. The distance between the two rows varies uniformly from 8 ft. at the shore end to 14 ft. at the outer end. A minimum penetration of 10 ft. is required, with, if possible, at least 2 ft. in hardpan. Each row of piles will have an outside wale composed of two 6 x 12-in. timbers bolted to every pile. Tie rods 8 ft. apart will pass between the piles and through the wales, the rock fill being hollowed out to form a trough under each rod, so that the rods will be embedded later in the concrete cap. Riprap will be placed outside of the piling, as shown. Experience has shown this to be important, as a number of piles not thus protected were thrown over in a recent storm, apparently due to scour along the toe of the piling.

On the lake side every third pile is to extend 15 in. above the water level and on the harbor side every fourth pile will extend 24 in. above this level, these pile heads being gained or grooved horizontally to form a bond with the concrete cap. Burlap will be laid over the rock fill to prevent the concrete for the superstructure or cap from escaping between the stones. The outer side of the superstructure will have a slope of 1 on 3.12. Piling and filling will be completed this season, but concreting will be left until the spring of 1922, thus allowing ample time for the fill to settle and become stable. The concrete superstructure will be constructed with joints at 50-ft. intervals, these joints being filled with four layers of felt.

Dense Concrete—In order to obtain as dense a concrete as possible for marine work, the specifications provide for a mixture of 1 part cement to 4 parts of coarse aggregate and a variable amount of sand. The coarse aggregate consists of stone passed by a 2-in. screen and retained on a ¼-in. screen. The amount of sand will be determined experimentally as follows: To a representative sample of the dry stone having a fixed volume (not less than 5 cu.ft.) will be added a fixed volume of dry sand, and after thorough mixing, the weight and volume will be determined. After repeating this process several times the proportion of sand that gives the heaviest mixture per unit of volume can be determined and this proportion used in mixing the concrete. These tests will be conducted every 24 hours, or as often as the characteristics of the stand or stone vary.

Forms are to be smooth and water-tight, and of such height as to protect the concrete from wave action while setting. Surfaces not in contact with forms must be brought up slightly above the edge of the forms, struck off with a long straight edge and thoroughly compacted and smoothed by working and trowelling. These surfaces will then be protected from the sun, rain or spray until they have attained their final set. Forms will not be removed sooner than 36 hours after the concrete has been poured, and the surface will be kept wet and protected from the sun for a period not exceeding five days after pouring. The object is to obtain a dense concrete having a smooth surface without sharp edges or projections.

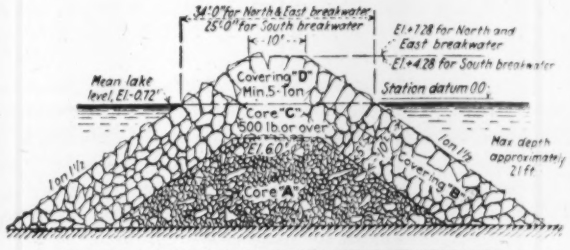


FIG. 3. ROCK RUBBLE MOUND BREAKWATER

Rock Rubble Mound Breakwater—In this construction, shown in section in Fig. 3, the core is of well graded quarry run stone with not to exceed 5 per cent of dust and having side slopes not exceeding 1 on 1½. Below the water level the slopes of the core are to be covered with stones weighing one ton or more, 85 per cent to weigh two tons or more. These will be deposited by derricks to a thickness of not less than 10 ft. On the top of the mound will be laid stones weighing 5 tons or more, with their long axes as far as possible perpendicular to the face of the breakwater, and with no surfaces projecting more than 10 in. outside or inside of the theoretical cross-section. These stones will be carefully set by derrick and will be wedged and blocked on the core by stones weighing not less than 500 lb. The covering stone above the water line is a hard dense and non-absorbent granite from Lohrville, Wis.; all other rock is a dense limestone from Lemont, Ill.

Concrete Caisson Breakwater—This construction is used only at the harbor entrance, where the rubble mound breakwater would greatly decrease the navigable opening of the harbor due to the long subsurface slopes of rough stones. Hollow reinforced-concrete caissons 54 ft. long, of the form shown in Fig. 4, will be floated into place and sunk on a bed of rock deposited in a dredged trench. This trench will be dredged to a depth

of 4 ft. unless hardpan is encountered at a depth of less than 3 ft. below lake bottom, in which case the trench will extend only 1 ft. into the hardpan.

In the trench will be deposited rock varying in size up to 500 lb. to within 2 ft. of the lower surface of the caissons. On this will be 2 ft. of rock from 10 to 100 lb., well graded and leveled to uniform elevation. The subfoundation will be laid this season and the foundation and caissons placed next spring. The caisson foundation will be protected by rip-rap.

The caissons will be sunk by filling them with water and will then be filled with rock varying from ordinary minimum run-of-crusher size to 500 lb. stone, to within 3½ ft. of the top. After 30 days, the filling will be covered with 6 in. of lean concrete, on which will be the cap or superstructure of concrete, conforming to the specification described above for the superstructure of the pile and rock fill breakwater. These caissons will be built at the plant of the U. S. Army Engineers at Milwaukee, Wis., in accordance with the War Department standard design as prepared originally by Col. W. V. Judson, U. S. Corps of Engineers (see *Engineering News-Record*, Aug. 8, 1918, pp. 258 and 287). They will be delivered to the contractor in the harbor of Waukegan, Ill.

Unit Cost of Breakwaters—This combination design of harbor protection at Great Lakes affords an interesting comparison of the costs of the three types of breakwaters. The contract has been awarded on the lump sum basis, but the following is an estimate of the average cost per linear foot.

Type 1. Rock Filled Pile Crib—Piling, timber, rods, etc., $35.82; rock fill, $24.08; concrete cap, $43.35; total, $102.25.

Type 2. Rock Rubble Mound—Core stone A, $37.84; core stone C, $23.92; cover stone B, $91.24; cover stone D, $71.50; total, $224.50.

Type 3. Concrete Caisson—Dredging, $6.90; foundation, $31.98; rip rap, $17.84; filling, $28.70; placing, $11.30; concrete cap, $34.78; caisson (furnished by U. S. Government), $90.75; total, $222.25.

Studies for the harbor design at Great Lakes, the determination of the most suitable types of breakwater and plans and specifications for the work were prepared by Commander Walter H. Allen, Civil Engineer Corps, U. S. Navy, public works officer of the Naval Training Station, and were approved by Rear-Admiral C. W. Parks, chief of the Bureau of Yards and Docks, U. S. Navy Department. In May, 1921, the contract was awarded to the Great Lakes Dredge & Dock Co., Chicago, at a lump sum price of $967,326. The concrete caissons are estimated to cost $4,900 each. The cost of the breakwater complete will approximate $1,026,126.

Construction work is under the direction of Commander Allen, public works officer of the training station, whose assistant is Lieutenant Henry Niemann, civil engineer corps, U. S. Navy.

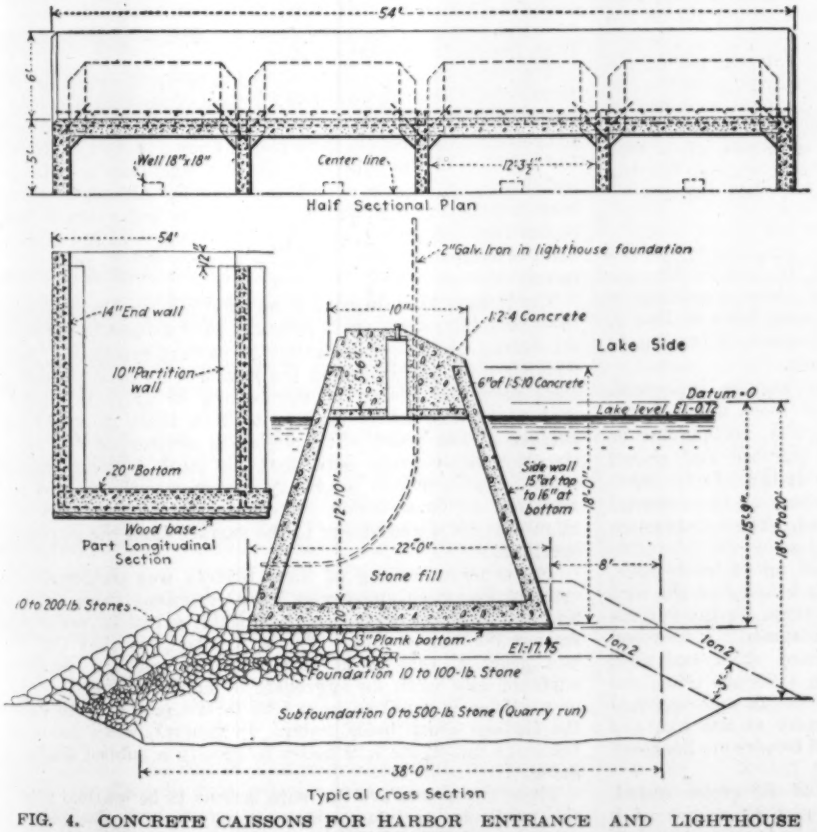


FIG. 4. CONCRETE CAISSONS FOR HARBOR ENTRANCE AND LIGHTHOUSE SUPPORTS

Highway Bridge Fire Protection Under Study

Fire protection principles for highway bridge floors are being studied by a joint committee formed under the auspices of the American Wood Preservers' Association. George W. Booth, chief engineer of the National Board of Fire Underwriters, 76 Williams St., New York, is chairman of the committee, and E. F. Kelley, bridge engineer, U. S. Bureau of Public Roads, Washington, is secretary. At the initial meeting, held at New York on Dec. 13, bridge-floor fire experiences and various means of protection were canvassed. A study of current floor designs from the fire-protection standpoint was decided upon, to reveal the principal points of weakness of floors from the fire standpoint. In connection herewith the committee desires information and opinions from engineers connected with the design and maintenance of highway bridges as to start and spread of floor fires. It is expected that the influence of creosoting practice on the fire risk will be taken up later. The work to be done will, in the committee's opinion, bear mainly on long bridges, in which the spread of fire is an important factor in the result, but it is thought that the principles developed will also prove of value in application to smaller bridges. The committee includes C. M. Taylor and L. T. Ericson of the American Wood Preservers' Association, F. E. Schmitt, *Engineering News-Record*, and D. F. Holtman, National Lumber Manufacturers' Assn.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

One Example of Wage Reduction

Sir—With our publications full of the questions of lower wages and lower building costs it seems that the question of a living wage for the construction engineer has been put in the background.

These men, always underpaid, are now forced to accept cuts in salary out of all proportion to the increases, however slight, which they received during the war.

The writer, like many others, served in the Engineer Corps abroad during the war, returned in 1919, located in a new job, only to be laid off when the depression came, and accepted an offer to go into the field at a cut of about 40 per cent, being told that "the war is over" and that wages had returned to a pre-war status. Imagine then our chagrin to see the weekly pay rolls still carrying carpenters at $60 a week, bricklayers, masons and foremen running anywhere from that figure up to $70 per week and getting it steadily. Is it justice to hold a man who has given four or five years of his life to the study of his profession and as many more to preparing himself in experience, to a salary of $40 or $50 a week because he is not backed by a labor union? And on top of this to hold him responsible for the acts of omission and commission of the various foremen whose weekly envelopes put his to shame.

The woods are full of good men out of work but that is no reason that those who are fortunate enough to be working should not receive a salary commensurate with their ability and responsibilities. The contractor of today is pointing an accusing finger at the labor unions as the cause of the high building costs and on the other hand is giving a pretty good indication of what he would do to them if they had no union by the way in which his engineering forces are cut to the bone.

The older and wiser heads of the great engineering societies frown on any suggestion of their giving support to a demand for a living wage for the younger members of the profession and intimate that we are becoming too commercial and losing sight of the definition of a true engineer. And yet the pot must boil and without stirring the broth is certainly mighty thin. "EX SERVICE."

Brooklyn Theater Roof Trusses Criticized

Sir—The collapse of the roof of the theater building in Brooklyn, on Nov. 29, as reported in your issue of Dec. 8, p. 9, is—contrary to the opinions expressed—rather due to faulty design than to poor erection work.

The roof trusses were not of the regular type with straight bottom chords, but of one of those many forms that appear occasionally, when triangular, rectangular or trapezoidal trusses do not suit the purpose and arched trusses are found to be too difficult to design. In the form chosen for the trusses the elastic nature of the material seems to have been entirely overlooked. The construction as well as the result point to this.

When trusses of such forms are laid up on brick walls, one end is preferably placed on a roller bearing on the wall to allow the changes in length of the truss for the various loads to take place without undue resistance. If one end of such roof trusses rests on a girder which can yield laterally between its points of support, while the other end rests on a brick wall, the changes in length will probably lead to a lateral deflection of the girder at the top, and it surely will if the other end of the roof trusses are anchored to an unyielding brick wall.

Had the column on which one end of the girder rested, been connected to a bearing on its pier by means of a longitudinal pin, and had the roof trusses been anchored to the wall, the structure would probably still be standing, but as the column rested squarely on its foundation a considerable resisting moment due to the load was developed at the foot when the lateral deflection of the top of the girder took place. This resisting moment caused stresses in the column and its extension, a strut rigidly connected to the column and serving as support for the roof truss. Anchor bolts at the foot of the column could not have prevented the development of such stresses.

The starting point of the failure seems to have been at this vertical strut. Its buckling under the combined stresses from the load of one-half of the end truss and from the aforesaid bending moments let the end of the truss down, and this truss pulled the column and the end of the girder along in its fall and inward, the latter rotating about the support at the other end. The damage to the brick wall at this point is rather due to the reaction from the heavy blow when the end of the girder struck the ground than to anything else. The damage to the piers elsewhere is probably entirely due to the pulling down of the trusses. Such piers are not ordinarily expected to stand abuse of this sort. The diagrams shown in connection with your description of the wreck suggest a mode of failure as indicated above. Had there been a kneebrace at the end truss, or had the column been carried up to the top of the longitudinal truss, the failure would probably have been avoided.

Apparently there are several errors in the design. They are easily enough spotted when one's attention is drawn to their presence, but somehow they seem to have a chance to slip by unnoticed here and there occasionally for one reason or another.

New York, Dec. 17. E. R. T. BERGGREN.

Must Cover Reinforcement Well

Sir—I read the article in *Engineering News-Record*, Dec. 8, 1921, p. 924, regarding the deterioration of concrete bridges in Nashville and as I was passing through that city recently I stopped off and took a good look at these structures. It seems to me that your correspondents have not placed sufficient emphasis upon the principal lessons to be learned from the condition of these structures.

The most glaring defect is the insufficient covering of reinforcing steel. In hundreds of cases of spalling observed by the writer, the very apparent cause was the fact that the reinforcing members were placed from ¼ in. to 1 in. from the surface of the concrete. Such a condition as this is sufficient explanation of all the troubles although there may be contributing factors. There was not a single instance that the writer could find in the course of his superficial investigation where spalling occurred due to any other cause.

The lessons to be learned from this fact are lessons that have been taught for years by many such defects in various structures, of various materials in various places, i.e., the disigner must so proportion the members as to allow sufficient room for reinforcing members to be properly placed without coming nearer than 1½ to 2 in. from the concrete surface at any point. The engineers responsible for construction must make sure that no steel, whether main reinforcing members, secondary members such as stirrup and ties, or construction members such as wire ties, is allowed to be placed nearer to the surface than the distance specified.

The concrete railing of these bridges was composed of crushed limestone aggregates of a somewhat flaky shape, and the surfaces were scrubbed while green in order to remove the cement film. The writer believes that this is bad practice, that it is permissible to use the washed surfaces only when an aggregate of hard rounded pebbles or particles is usual so as not to form small pockets over the surface which holds water. In general, when using a limestone aggregate it is better to specify a rubbed surface finish.

These two points are the main lessons to be learned from this particular case but perhaps it may be well also to call attention of concrete designers to the great difficulty of

obtaining waterproof concrete in field operations, and the necessity of getting planty of good concrete around all reinforcing members, especially between reinforcing members and surfaces exposed to an atmosphere charged with corrosive gases.

There is one more point well illustrated by this case as well as by many others examined by the writer; that is the necessity of covering properly all secondary members. I have seen instances where the end of a ¾-in. tie, for column rods, came so close to the concrete surface that rust started at this exposed end, causing a very small piece of concrete to be spalled off by the expanding rust; then the rusting pentrated deeper and deeper, spalling off larger and larger pieces until the main reinforcing was reached and corrosion started on it, spalling off the protecting concrete regardless of its thickness or its physical condition. The only way to prevent this progressive corrosion is to make sure that it don't start. WILBUR J. WATSON.

Cleveland, Ohio, Dec. 15.

Technical Supervision of Construction Required on Public Work

Sir—In your editorial on "Engineers or Builders," Dec. 8, p. 923, I note the sentence, "At any rate, as yet no community, no city or state, has made professional supervision of building a legal requirement." I would call your attention to Section 19 of the Michigan registration act, which reads as follows:

> Sec. 19. After the first day of March, 1920, neither the state, nor any county, township, municipality or village, shall engage in the construction or maintenance of any public work of an architectural or engineering character, for which construction or maintenance, the plans, specifications and estimates shall not have been prepared by a registered architect or a registered engineer under this act with qualifications appertaining to such work, *and the construction of which is not supervised by such a registered architect or registered engineer;* provided, That nothing in this section shall be held to apply to items of maintenance, repair or construction wherein the contemplated expenditure for the completed project does not exceed two thousand dollars.

This does not wholly vitiate the correctness of your statement, but it goes a little way toward showing a tendency toward better things. GARDNER S. WILLIAMS,

Ann Arbor, Mich., Dec. 19. Consulting Engineer.

Sir—Your editorial in the issue of Dec. 8, p. 923, under the caption "Engineers or Builders?", states—"as yet no community, no city or state has made professional supervision of building a legal requirement." Alas! this appears too true, in spite of the fact that engineers' registration laws have been enacted in a number of states.. The general intent of licensing engineers undoubtedly is to protect the public from accidents and bad construction by legally requiring the services of competent engineers. Drafts of registration bills have been drawn, particularly by the American Association of Engineers, in which design and supervision of construction by registered engineers were requirements. But when the bills were entered, the proponents evidently lost nerve, cut out the essential part, and generally provided only that no one should call himself a registered engineer unless he was one. Thus the chief purpose of registering engineers is lost and the result has simply been to force other states to register engineers, first for reciprocity to protect their own engineers from being discriminated against, and second to keep out incompetents leaving states that have registration laws. Nothing is worth doing unless fearlessly done right. May we not hear from engineers from the different states the history of this important point: the legal requirements of professional design and professional supervision of construction?

The same article states that some building officials are advocating licensed builders but that no practical trial has been made. The city of Boston requires that no construction work shall be done unless a man is on the job who is licensed to take personal charge or control of the work. John F. Hickey is chairman of the board of examiners. Licenses are issued to builders to construct different classes of buildings as stated in the license, and as determined in each case by the board after considering a written statement of experience and work done and an oral examination. Licenses may be revoked on account of complaints against a man for failure to perform his duties properly, and are renewable each year after an examination as to what the licensee has done and any complaints against him. A hardship has developed in the requirement that the licensed master builder must remain continually on the job, even though it were a small job in some one branch of the work that could be left in charge of a competent foreman. To obviate this, licenses are now granted also for different trades.

While it is as advisable to retain an engineer or architect to supervise construction and design as it is to retain a doctor for an operation on the body, so also it is the same advantage to have tried and licensed builders (and even foremen) as to have a trained nurse to carry out the doctor's orders. The engineer may give instructions and advice, and condemn bad workmanship, but undoubtedly good workmanship rather than making good the bad workmanship is most economical and is essential and can be best attained by the experienced workman under the control of an experienced foreman.

Yet engineering is required for construction as well as good and proper workmanship. Your advocating compulsory supervision of building work by the engineer or architect is sound policy. Massachusetts (including Boston) lacks that. Boston's licensed builders undoubtedly get good workmanship and the work is duly inspected by city building inspectors. Besides the designs are inspected by engineers of the building department. But compulsory supervision of construction by an engineer or architect is not required and is often neglected by an ignorant owner who is penny-wise and pound-foolish and employs an engineer or architect only to design the work, and that simply because of the requirement of the building department for satisfactory plans.

Failures in buildings occur generally during construction, and more often are chargeable to the lack of a competent construction engineer, than to poor workmanship. Therefore, for the safety of the public the laws should enforce employing the services of a competent engineer or architect for the supervision of construction as well as for the designing.

After all is done, accidents will happen in the best regulated families. Often designs are made without a view to the practical operation of construction. The deflecting of a long truss when the load is being applied may throw an eccentric stress on a column and cause the column to kick out and throw the whole structure, unless it has been designed for this stress. And yet such a design may be passed by a building department engineer as satisfactory to hold, if the building were completed.

But who has to pay the cost of examinations, and registrations? The poor engineer! FREDERICK O. LEWIS,

Boston, Consulting Architect and

Dec. 17. Construction Engineer.

Actual Stresses In British Impact Tests

Sir—Referring to your extremely interesting report on certain impact tests for British bridges, Oct. 20, pp. 642-645, the writer would like to point out one or two features suggested by a study of the table of results.

Because of the fact that in our bridge specifications and practice the increment for impact, etc., is added to the *calculated static* live-load stress and not to any recorded stress, the attached supplementary column A has been figured to show the ratio between column 14 of the original table, which gives the maximum recorded live-load stress, and column 12, the calculated static live-load stress. This is the only set of figures which, strictly speaking, can be compared with the results obtained from any of our actual formulas. Examining this table we find at once the effect of the phenomenon noted in the text of your article, that the live-loads as figured, even from definite concentrations, very seldom occurred in the

members. Out of 59 cases, 43 show the sum of live-load plus increment to be less than the calculated static live-load. One case is obviously a freak; it is a web measurement, and a great deal more information would be required in order to properly appraise its significance. One other case shows an increase of 92%, two show about 50%, two show about 35%, and the remaining ten are between 5% and 20%. Plotting these figures on your Fig. 2, p. 644,

LIVE-LOAD STRESS RATIOS AND UNIT STRESSES IN BRITISH IMPACT TESTS

A Col. 14/Col. 12 Actual/calc't'd	B Col. 11 + Col. 14 Total Actual Unit, Lbs./Sq.In.	C Col. 11 + Col. 12 + imp. = 300/300 + I Designing Unit, Lbs./Sq.In.
0.64	6,100	15,100
0.84	2,800	6,100
0.66	7,400	18,900
0.64	6,700	17,800
1.92	7,400	7,600
1.36	5,300	7,600
0.62	5,600	14,900
0.40	4,200	17,600
0.61	4,200	11,900
0.55	3,800	11,900
1.31	5,300	7,500
0.82	6,700	14,600
0.61	3,900	8,000
0.75	7,200	18,100
0.72	6,500	16,500
0.58	13,400	30,600
1.48	8,800	11,400
0.94	8,400	15,900
1.07	7,600	13,300
1.05	5,800	9,500
1.18	5,400	8,400
0.75	5,800	11,800
1.12	4,300	6,400
0.79	6,200	12,800
0.83	10,400	19,200
0.96	2,500	4,400
0.89	6,700	11,800
0.83	4,700	9,800
0.96	5,500	9,900
1.04	4,700	7,300
0.66	7,600	15,700
0.30	4,900	16,700
0.17	4,700	11,200
0.34	6,700	14,300
0.89	5,500	8,900
*3.37	4,000	2,500
0.98	5,300	8,200
0.68	8,800	17,300
1.04	10,300	16,100
0.78	9,900	19,000
0.59	9,200	13,600
1.02	8,700	11,100
0.63	6,600	12,700
0.48	3,700	8,200
1.05	5,900	8,300
0.75	2,700	4,500
1.51	7,100	7,900
0.73	9,700	15,700
1.18	9,800	12,500
1.12	12,400	17,400
0.66	6,600	12,900
0.82	6,900	11,300
0.50	5,400	11,300
0.50	8,300	18,800
0.40	6,500	16,400
0.75	7,400	11,800
0.57	7,600	14,400
0.96	7,900	11,400
0.48	6,900	14,100

gives quite an uninterpretable series of points, palpably insufficient for the derivation of any formula.

Another interesting point is provided in the determination of the actual total unit stresses, using the calculated dead-load unit and the maximum recorded live-load, including increment. Column B of the table herewith shows these units in pounds per square inch. They seem distinctly safe.

An examination was also made of the unit stresses as they would appear on a stress sheet, using the calculated dead-load unit, calculated live-load unit, and an increment for impact given by the Schneider formula—300/300 + I. Column C shows these resulting "working" or "designing" stresses, and reveals a remarkable range, running from 4,500, excluding the freak case before mentioned, to 30,600 lb. per sq.in. As these live-loads are supposed to be produced by "one or two locomotives, typical 2-cylinder passenger type, chosen from approximately the heaviest on each system" they must be reasonably close to the specified loading for which the bridges are figured, and the units in column C would indicate a very wide difference in practice, and would serve to strengthen any argument for a certain measure of standardization in design, or at least standardization in calculation methods.

If there is one result more outstanding than any other from a study of this article and the accompanying table it is that, until we know a great deal better than we would seem to know at present how our live-loads are actually taken up, it is mis-spent zeal to keep continually revising and refining our impact allowance.

Montreal. P. L. PRATLEY,
Oct. 26. Consulting Engineer.

Assisting the Geological Survey

Sir—I would like to call the attention of all railway engineers to the article by Geo. W. White, in the *Engineering News-Record*, for Nov. 10, p. 764, regarding the methods adopted by the Southern Ry. for its resurveys, particularly the statement that all lines were referred to true north as determined by observations on Polaris.

For some time past, the U. S. Geological Survey has been conducting an educational campaign in its endeavor to induce railway and highway engineers to refer all survey lines to true north rather than to magnetic north. If true bearings for railway and highway alignment surveys were available the Geological Survey could, without further field traverses, compute accurate geographic positions from them and use them for the control of topographic maps, thereby saving from 5 to 10 per cent in the cost of completing the topographic mapping of the United States. This is, therefore, a matter of no little importance especially in view of the insistent demand for economy and the small appropriation made by Congress for map work.

The Geological Survey has prepared instructions for azimuth observations on the sun and on Polaris, which it is glad to send free to engineers, engaged in railway or highway surveys. If engineers generally knew how easy it is to make such observations when proper methods are employed, more would attempt it. When the air is reasonably clear Polaris can be seen with a good transit telescope for several hours before sunset and by taking advantage of this fact one objection to the measurement of true azimuths can be removed. C. H. BIRDSEYE,

Chief Topographic Engineer,
Nov. 14, Washington. United States Geological Survey.

Automobiles Kill More Than Typhoid Census Figures Show

Automobiles caused more deaths than did typhoid fever or railways in the registration area of the United States in 1920, according to the Bureau of the Census. The 1920 figures are: Automobiles, 9,103; typhoid fever, 6,805; railways, 6,426. The respective mortality rates per 100,000 are 10.4, 7.8 and 7.3. The registration area in 1920 included 34 states, the District of Columbia and 16 cities in non-registration states, with an estimated mid-year population of 87,486,713 or 82.2 per cent of that of the whole United States. Nebraska, with an estimated mid-year population of 1,301,737 was added to the area in 1920. It is also interesting to note that the registration-area typhoid mortality in 1919, despite the lower population, was 7,860, a rate of 9.2 per 100,000 as against the 6,805 and 7.8 rate for 1920, which is noted above.

HINTS FOR THE CONTRACTOR

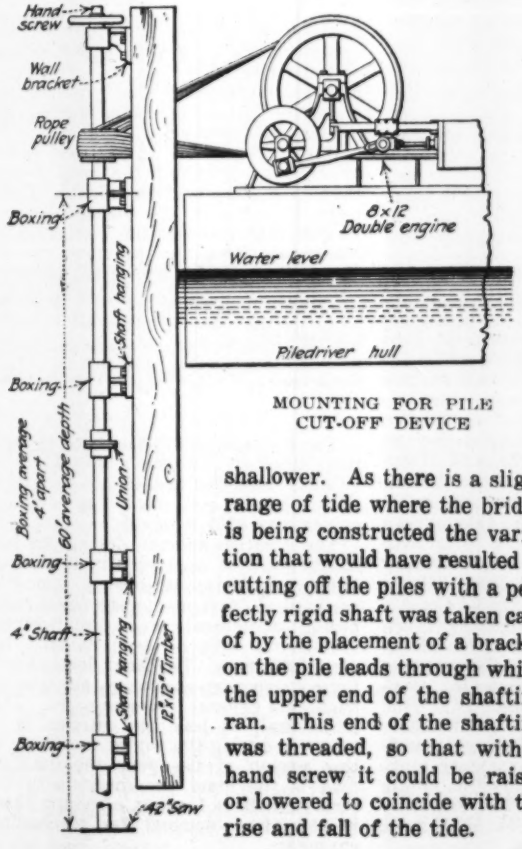
Hoe With Straightened Blade Spaces Paving Brick

USING lugless brick, in paving in Scott County, Iowa, even joints and proper spacing, to get full penetration of the bituminous filler, were secured by laying the bricks rather loosely and then spacing them by eye, using a hoe with a straightened blade. An ordinary hoe was used, with its blade bent by a blacksmith, straight out in line with the handle. The McCarthy Improvement Co., Davenport, Iowa, were the contractors.

Footing Piles Cut Off 60 Ft. Below Water Surface

BY FASTENING a 12 x 12-in. timber between the leads of a piledriver and attaching to it at intervals of about 4 ft. boxing which carried a 4-in. shafting, the McLean Contracting Co., of Baltimore, who are building the Long Beach bridge which connects Wreck Lead with Long Beach, Long Island, were able to cut off the footing piles for one of the central piers 60 ft. below the surface of the water.

The device used is shown in the accompanying sketch. It is not particularly new expect in that an unusual depth was necessary at which the piles were to be cut off. Piles of a length of 85 ft. were used and inasmuch as the penetration was around 25 ft. the piles could be used again on pier footings where the water was much



MOUNTING FOR PILE CUT-OFF DEVICE

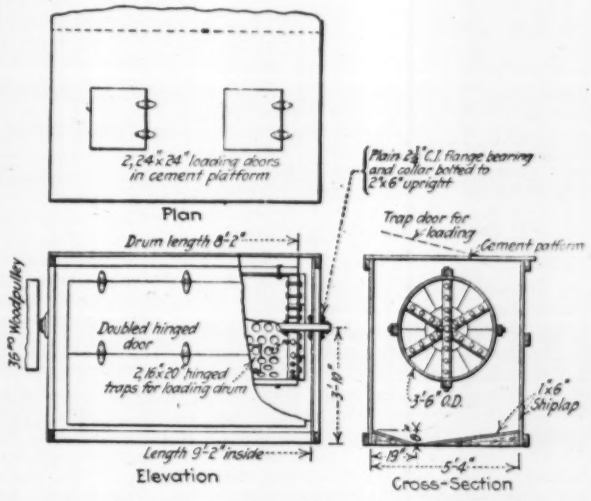
shallower. As there is a slight range of tide where the bridge is being constructed the variation that would have resulted in cutting off the piles with a perfectly rigid shaft was taken care of by the placement of a bracket on the pile leads through which the upper end of the shafting ran. This end of the shafting was threaded, so that with a hand screw it could be raised or lowered to coincide with the rise and fall of the tide.

At about the mid-point of the shafting was placed a union so that sections could be taken out or put in as desired.

The Long Beach bridge is being constructed by Nassau County, N. Y., under the supervision of W. Fred Starks, county superintendent of highways.

Homemade Sack Shaker Saves Cement

A MOTOR-OPERATED rotary rock screen salvaged from other work was recently adapted by engineers of the San Joaquin Light & Power Corporation to serve as a cement sack shaker. One laborer operated the device, dividing his time between loading and unloading the shaker, tieing up the sacks and gathering up the cement recovered. Ordinarily he handled about 800 sacks per day. The sacks were put in the screen in lots of 50 and each lot was turned about 30 minutes at the rate of 50 r.p.m.



ARRANGEMENT OF SCREEN AND HOUSING FOR SACK SHAKER

The product of this operation was 8 sacks of cement per day or twice the laborer's hire of $4 for 8 hours. Besides the cement recovery, there was a considerable saving in freight and truck haul. In putting 59,680 sacks through this shaker the value of cement recovered was $504; the freight saving was $184 and truck haulage $61.50, a total of $749.50. The cost of rebuilding and setting up the old screen so it would be useful for this purpose was $395.

New Tests of Timber Columns in Progress

Column tests for the purpose of determining the effect of density, and defects such as knots, checks, cross-grain, etc., on the strength of structural columns of Southern pine and Douglas fir have just been started at the Forest Products Laboratory, Madison, Wis., under the direction of J. H. Newlin of the laboratory and D. F. Holtman of the National Lumber Manufacturers' Association. The experiments will cover a period of four years, and the data will be used as a basis for recommending safe working stresses for structural columns.

NEWS OF THE WEEK

New York, December 29, 1921

Road Builders Announce Convention Program

Technical Papers Cover Bituminous and Concrete Types, Financing, Traffic and Research

The American Road Builders Association has announced the following tentative program of technical papers for its twelfth annual convention to be held in the Coliseum, Chicago, Jan. 16-20:

Bituminous Roads — "Bituminous Foundations": Hugh W. Skidmore, Chicago Paving Laboratory; "Selection of Bituminous Wearing Course": C. M. Pinckney, chief engineer, Bureau of Highways, Borough of Manhattan, New York City; "Utilization of Local Material for Mineral Aggregate": Major W. A. Welch, chief engineer, Palisades Interstate Park Commission, New York; "Asphalt Specifications": L. M. Law, chief chemist, New Orleans Refining Co.; "Specifications of Mineral Aggregates": Roy M. Green, manager, Western Laboratories, Lincoln, Neb.; "Controversial Construction Requirements in Specifications": Bruce Aldrich, Toronto, Canada; "A Simple Graphic Method of Proportioning Sands for Sheet Asphalt Mixtures": Prevost Hubbard, chemical engineer, The Asphalt Association, New York City.

Cement Concrete Roads—"The Selection of the Mineral Aggregate for a Portland Cement Concrete Road": John H. Mullen, chief engineer, State Highway Department of Minnesota; "Design of Concrete Roads for Heavy Traffic": W. D. Uhler, chief engineer, Pennsylvania State Highway Department; "Inspection and Control of Materials for Concrete Roads": R. W. Crum, testing engineer, Iowa State Highway Commission; "Importance of Surface Finish and Methods of Control": H. E. Breed, consulting engineer, N. Y. City; "Single Track Concrete Roads for the Average County": P. C. McArdle, county highway superintendent, Vermilion County, Danville, Ill.; "Pavement Widths for Highways Serving Large Cities": Edward N. Hines, chairman, Board of County Road Commissioners, Wayne County, Detroit, Mich.

Common Roads—"Common Roads": T. J. Wasser, state highway engineer, Trenton, N. J.; "A Systematic study of Gravels for Road Purposes": Wallace F. Purrington, chemist and testing engineer, New Hampshire State Highway Department.

Highway Financing—"The Proposed Wisconsin Plan of Highway Finance": A. R. Hirst, chief highway engineer, Wisconsin Highway Commission; "The Minnesota Experience in Highway Financing": C. M. Babcock, commissioner of highways, Minnesota Highway Dept.

Highway Transportation — "Truck Overloading, Its Relation to Road Construction and Maintenance": J. G. McKay, Professor of Economics, University of Wisconsin.

Highway Research — "Highway Research": W. K. Hatt, Professor of Engineering, Purdue University and Director of research, National Research Council; "The Illinois Experimental Road": Clifford Older, chief highway engineer, Department of Public Works, Illinois; "Highway Researches and What the Results Indicate": A. T. Goldbeck, U. S. Bureau of Public Roads.

Miscellaneous — "The Highway Outlook": Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Washington, D. C.; "Cost Keeping on Highway Construction": A. R. Losh, Bureau of Construction, U. S. Bureau of Public Roads, Washington, D. C.; "Development of Small Stream Valleys into Traffic Routes": Jay Downer, chief engineer, Bronx Parkway Commission, New York; "Uniform Legislation as Affecting Highway Traffic and Highway Transport": D. C. Fenner, Manager, Public Works Department, International Motor Co., N. Y. City; "Construction and Maintenance of Earth Roads": George E. Johnson, Secretary of Public Works, Lincoln, Neb.; "Highway Construction on the Pacific Coast": Herbert Nunn, State Highway Engineer, Salem, Ore.; "Co-operation of All Parties Interested in the Construction of a Modern Road": William Ord, manager, paving department, Lakewood Engineering Co., Cleveland; "The Business End of a State Highway Department": Charles M. Upham, state highway engineer, North Carolina State Highway Commission; "The Highway Contractor's Problems": H. H. Wilson, Winston Bros., Muncy, Pa.

Building Code May Prohibit All Non-Fireproof Hospitals

The Wisconsin State Industrial Commission is considering an amendment to the state building code which will require all hospitals hereafter constructed to be of fireproof construction. At present only hospitals of three or more stories in height must be fireproof.

Hoover on Colorado River Commission

The President has appointed Secretary of Commerce Hoover as federal chairman of the Colorado River Commission, created by Congress and the States of California, Arizona, Nevada, Utah, Colorado, Wyoming and Montana. It is the duty of the Commission to determine a plan for the control of irrigation, power and flood protection on the Colorado River.

Chile Halts Public Works

Owing to the high rates in effect on Chilean railroads serious attention is being given to the construction reports in the agricultural sections of southern Chile, according to cable advices to the U. S. Department of Commerce. The same cable announces that road-building funds have been exhausted and that the Government is retrenching and will undertake no new public works.

California Water Commission Has New Head—Moves to Sacramento

Paul Bailey formerly a deputy of the California Water Commission and more recently assistant to Austin B. Fletcher, director of the State Board of Public Works, has been named chief of the division of water rights succeeding Chas. H. Lee. The position held by Mr. Lee for two years was declared vacant by Mr. Fletcher on December 1 after a difference of opinion had arisen over the advisability of moving the headquarters of the water rights division from San Francisco to Sacramento.

The reorganization of California state departments which made the water commission a subdivision under the jurisdiction of the Board of Public Works went into effect last July and was reported in *Engineering News-Record*, July 28, p. 166. Mr. Fletcher retains his position as chief engineer of the state highway commission at the same time that he heads the Board of Public Works.

Engineering Employment Shows Year-End Pause

A year-end pause in engineering employment is apparent from a survey of conditions made by the employment department of the American Association of Engineers Dec. 1, based on reports from 25 widely separated localities. In comparison with reports and surveys of other years a lull in the demand for engineering services is usually experienced at this time with a resumption of activities after Jan. 1. From the seasonal standpoint the greatest demand for engineers comes during the spring and summer.

During November 12 per cent fewer applicants registered for employment than during the previous month. There were 20 per cent less placements and 13 per cent less positions received in November than the previous month. The following table shows the trend:

	Nov. 1921	Oct. 1921	Nov. 1920
Applicants for employment	1,661	1,877	1,763
Positions received	335	384	717
Men referred	1,639	1,731	3,506
Men placed	193	240	313

The average monthly salary of positions filled in November was $192, or $6 more than the last month. For the same month last year the average salary was $201 a month.

The greatest demand during the last month was for engineers in the industries and designing offices, including mechanical draftsmen, mechanical engineers, structural and architectural draftsmen, with a large demand for map draftsmen. The least demand was for construction engineers, superintendents and general civil engineers. This is natural, as less construction is in progress during the winter months. At this season of the year the drafting field is the most prominent with the structural lines leading, although there is a healthy demand for mechanical engineers.

Minnesota Gets Low Prices on Winter Road Work

Notably low prices on grading, gravel surfacing and paving were received by the Minnesota State Highway Department, as announced by C. M. Babcock, commissioner, on "winter work" trunk highway projects for which bids were opened Nov. 29 and 30 Dec. 2. On the seven grading jobs advertised, a total of 76 miles, bids for excavation ran from 19 to 27c per cubic yard, with an average of 23c as compared with a range of 23 to 40c, and an average of 37c for last summer's work. On 25 graveling projects, totaling 260 miles, bids ran from 16 to 28c per cubic yard per mile haul, about one-half of the prices obtained for the summer program. On the one job of paving, a 25-mile section of concrete, the low bid was less than $24,000 a mile as against $27,000, the lowest of last summer. Final awards are awaiting rechecking.

Move to Span Pend O'Reille River

A movement to span the Pend O'Reille River, in Eastern Washington, with a $200,000 concrete and steel bridge has been undertaken by the communities of Priest River and Sandpoint, Idaho. The Interstate Toll Bridge Co., with an authorized capital stock of $200,000, has been formed, and the bridge will be constructed at Newport. It will provide a new route for tourists who branch off the Yellowstone Trail, and will open a new route from Missoula to Spokane, carrying traffic on not less than six important highways.

The bridge will be 1,224 ft. long, having five steel spans, resting on six reinforced concrete piers. It will have a width of 20 ft. in the clear, and will give a 65-ft. clearance, allowing free passage of vessels and obviating a draw span. The plans for the structure have been drawn by the Union Bridge Co., of Seattle, the firm now building the Kennewick-Pasco bridge, and plans have been approved by the engineers of the War Department. The bridge will replace the present unsatisfactory ferry service on the river.

Acceptance Seattle Water Bonds Brings Storm of Protest

The Seattle city council recently accepted a bid for $2,000,000 water extension revenue bonds, which has brought a storm of protect from Mayor Hugh M. Caldwell, superintendent of water L. B. Youngs and business men of the city. The bonds carry interest at 6 per cent and the bidders offer to pay par and accrued interest. The bid is alleged to have been secretly accepted by the council without the approval of the superintendent of water, or of Mayor Caldwell, and it is declared will mean a loss of $60,000 to $100,000 to the water department. Mayor Caldwell expressed the belief that a public sale of the bonds would have brought the city a premium of from one to five per cent above par value.

The bonds are part of a $6,000,000 issue authorized several years ago to finance extensions to the municipal water system, including construction of an impounding basin at Swan Lake, a pipe line from there to the city, and a proposed reservoir at Volunteer Park. It is considered likely that the sale may be declared void and the bonds placed in the open market.

California Water Resources Board Begins Statewide Inventory

The California state legislature in June, 1921, appropriated $200,000 for a statewide survey of water resources to be made under the direction of the state department of engineering. The bill instructs the engineering department to "determine the maximum amount of water which can be delivered to the maximum area of land, the maximum control of flood waters, the maximum storage of waters, the effect of deforestation and all possible and practicable uses for such waters in the state of California."

The bill also requires the state engineering department to "determine a comprehensive plan for the accomplishment of the maximum conservation, control, storage, distribution and application of all the waters of the state and to estimate the cost of constructing dams, canals, reservoirs, or other work necessary in carrying out this plan and to report the result of such investigations with recommendations not later than the legislative sesion of 1923."

Queenston-Chippawa Power Plant Opened

On Dec. 24, water was admitted for the first time into the nine-mile canal leading around Niagara Falls to the Queenston power plant of the Hydro-Electric Power Commission of Ontario. As this was written it had reached a depth of 40 ft. on the forebay side and the ceremony of turning over the first 55,000-hp. turbine was set for 2 p.m., Dec. 28. Details of the first step in the completion of the great Niagara power development will appear in a later issue.

Plan Is Comprehensive

In pursuance of a provision of the bill, the Governor appointed a consulting board of citizens to serve in an advisory capacity. This board consists of H. D. McGlashan, U. S. Geological Survey, San Francisco; B. A. Etcheverry, professor of irrigation engineering, University of California; H. Hawgood, consulting engineer; R. B. Marshall, Peter Cook, J. C. Forkner, and O. B. Tout. This advisory board has held public hearings in several parts of the state to permit residents to express their views with regard to the proposed study and recommendations.

Comprehensive plans are being worked out for the actual compiling of the inventory of water and power resources. All available stream flow and runoff records will first be listed. To aid in this work thirteen engineers of Sacramento, San Francisco and Los Angeles have been named to aid in gathering data in public and private offices that have a bearing on the desired records. When all existing information has been collected, it is planned to put reconnaissance survey parties in the field to gather the additional data needed. The first field party is already at work.

F. C. Scobey, hydraulic engineer, irrigation division, U. S. Bureau of Public Roads, has been "loaned" to the state department of engineering to take charge of the engineering studies involved. Paul Bailey is chief of the water rights division, state engineering department.

New York Zoning Discussed by Am. Soc. C. E. Section

Residence and Retail Districts Protected — Skyscrapers Curbed — Decentralization Needed

What zoning has done for New York City since its adoption in the summer of 1916 was the topic of the meeting of the New York Section, Am. Soc. C. E., in that city Dec. 21. The formal discussiong was opened by Edward M. Bassett, formerly rapid transit commissioner, and Lawson Purdy, for some years commissioner of taxes and assessments, both members of the committee that framed the New York zoning regulations.

Zoning, said Mr. Bassett, has kept industries out of residence and high class retail business districts; has kept commercial garages out of residence and business districts; and has ameliorated but not cured the skyscraper evil.

Mr. Purdy gave as one result of zoning in which he takes much pride that is excludes signs from residence districts by prohibiting all structures therein except residences. He expressed the hope that the time will come when the only outdoor signs that will be permitted will be relatively small ones advertising business conducted in the buildings on which the signs are affixed.

John B. Fox, secretary of the Murray Hill association, told of the fight that the association has had to keep up to Murray Hill residence section. He stated that, with one exception, the Board of Estimate had supported the association by not granting appeals for the admitting of business into the district.

Use Restrictions Important

Rudolph P. Miller, superintendent of buildings in the Borough of Manhattan, sent a paper in which he said, among other things, that while height restrictions come first to mind, the restrictions as regards use are of greater importance. As to the exact benefits of the height restrictions, it is yet too early to say, Mr. Miller stated, as thus far there have been only forty buildings that have come within the set-back limitations as to the upper parts of the buildings.

Clarence S. Stein, architect, New York City, laid stress on the desirability of devising some way of providing homes for workers near their working places as a means of lessening congestion. An examination of the map of New York City, he said, would show that a very small portion of the lower end of Manhattan is occupied by residences notwithstanding the fact that many people work there. He suggested mixed residential districts with business uses in the first story and residences above. Finally, Mr. Stein said that we are approaching the time when the worker will be in touch with his industry on one hand and with green fields on the other.

General Discussion

Among those taking part in the general discussion were H. H. Curran, president of the Board of Manhattan, and D. L. Turner, consulting engineer, Rapid Transit Commission, New York City. Mr. Curran said that to knit the five boroughs of New York City together is a problem in engineering that is unsolvable without zoning. The present

transit system he compared to a hub and spokes without a rim. He urged that instead there be a cobweb system so as to provide not only an outer circumferential, but also inner circumferential means of travel. Mr. Curran suggested fifty to seventy-five scattered districts in which the workers could live close to their industries, even though there might be short transit hauls of one-half mile to a mile, in contrast to the very long hauls between homes and workshops that exist today. Mr. Turner thought it a mistake to overemphasize the boroughs of New York City. The borough lines should be broken down, industry decentralized, and one large city made. There should be circular as well as radial lines of transit.

Would Fill Senate with Engineers

It would reflect more favorably on the progress of our civilization if there were more statues to engineers and fewer to soldiers. This thought was expressed by Lord Riddell in the course of remarks at the annual dinner Dec. 7 of the Washington (D.C.) Society of Engineers. Senator King, another of the speakers, said that the country would be benefited if the existing United States Senate were dismissed and each place filled with an engineer. Col. E. Lester Jones, director of the Coast and Geodetic Survey, served as toastmaster.

Herbert Quick, introduced as a literary engineer, cited instances to show that engineer representation on the governing bodies of great municipalities had resulted in such efficiencies that he believes county government should make use of its engineering rather than its professional political talent. While the railroads have utilized engineering talent very extensively in subordinate capacities, one reason why the railroads, in his opinion, are the most inefficiently managed great properties in the country is due to the fact that engineers have not had a voice in the broader questions of their conduct.

Completion of San Pablo Dam Adds to Oakland Water

Construction on the San Pablo water supply project for the city of Oakland, Cal., was started in August, 1916, by the East Bay Water Co. and the dam was advanced far enough to be used for storage in 1920. The dam has recently been finished and is to be used for storing the runoff this winter. It was built by the hydraulic sluicing method, is 110 ft. high, has a base width of 1,300 ft., a crest length of 1,250 ft. and contains about 2,200,000 cu.yd. of material.

In addition to the dam the project as a whole includes a 115-ft. concrete intake control tower, a 14,000-ft. concrete-lined tunnel with a capacity of 100,000,000 gal. per day and a rapid sand filtration plant with a normal capacity of 12,000,000 gal, per day.

William Mulholland of Los Angeles has acted as consulting engineer since the inception of the work. In the early stages Allen Hazen and John R. Freeman were also called in as consulting engineers. More recently J. M. Howells has been acting in this capacity. Geo. H. Wilhelm is vice-president and general manager of the East Bay Water Company and Geo. W. Hawley is engineer in charge of the San Pablo project.

May Purchase Cape Cod Canal

The purchase by the federal government of the Cape Cod canal has been recommended by Secretaries Weeks, Denby, and Hoover, who have informed congress that $11,500,000 would be a reasonable price for the property. Investigation of the acquisition of the canal by these three secretaries has led them to conclude that government control of it is desirable and the price reasonable.

Recommendation that the federal government acquire the property has been transmitted to Speaker Gillet and there accompanied the recommendation an agreement to be ratified by congress calling for the transfer of the canal property from the Boston Cape Cod & New York Canal Co. to the federal government.

Of the $11,500,000 purchase price, $5,500,000 would be a cash payment and the rest assumption of bonds now outstanding.

Discuss Engineering Aspects of Malaria Control

The third annual conference of malarial control field workers was held at Hot Springs, Ark., Nov. 15 to 17. Those in attendance were largely engineers and most of the twenty papers dealt with engineering work for malaria control.

The economic aspects of the subject were given particular attention. Among the papers were: "The Effect of Large Drainage Districts in the Mississippi Delta on the Control of Malaria," by L. L. Hidinger, president, Morgan Engineering Co., Memphis, Tenn.; "Use of Dynamite and TNT in Blasting Ditches," by J. T. Clarke, sanitary engineer, International Health Board, Greenwood, Miss.; "Economic Loss Caused by Malaria," by A. W. Fuchs, associate sanitary engineer, U. S. Public Health Service, Memphis, Tenn.; "Malaria Control in Memphis, Tenn.," by W. G. Stromquist, sanitary engineer, City Health Department, Memphis.

Alaska R.R. Nears Completion

With only 20 miles of track to be laid to close the gap in the interior section, the Alaska R.R. is rapidly approaching completion. This was the condition on Nov. 2. About 525 miles are in operation and it is expected that tracklaying gangs now working in both directions will reach Riley Creek, at Mile 347, on Dec. 1. (See *Engineering News-Record*, April 14, 1921, p. 632.)

Steel for the permanent high level bridge over Riley Creek has been shipped by the Phoenix Bridge Co. and it is expected to have this bridge completed by Feb. 1, giving a through line of rails from Seward and Anchorage to Nenana. The next work will be the permanent crossing of the Tanana River at Nenana. Connection with 85 miles of narrow-gage line north of the river is made now by means of a ferry in summer and by extending the narrow-gage track over the ice in winter. This Tenana River bridge and the widening of gage on the present track will give a through and unbroken railway line into Fairbanks. The railway is being built for the U. S. Government by the Alaskan Engineering Commission, of which Col. Frederic Mears is president and chief engineer.

Civil Engineers Will Discuss National Housing Problem

Following its monthly business meeting in the Engineering Societies Building, New York City, at 8 p.m., Jan. 4, the American Society of Civil Engineers will hold a conference on that evening and the following day on "The National Housing Problem." On Jan. 4 the broad economic phases of the subject will be discussed and on Jan. 5 the program provides for the consideration of "Planning and Zoning" at 10 a.m.; "Utilities," at 2 p.m.; and "Legislation and Financing," at 8 p.m. Nineteen speakers are scheduled to address the meetings.

Court Restores Civil Service Employee After 13 Years

Vindication of the validity of the civil service law as it pertains to employment in municipal service in Chicago is indicated by a "peremptory writ of mandamus" directed to the city, mayor, city treasurer, city clerk, city controller, each member of the city council and each member of the civil service commission to reinstate P. C. McArdle, with full back-pay allowance since 1908 as head of the testing division Bureau of Engineering. The legal battle which Mr. McArdle put up for reinstatement after being ousted started May 12, 1908, and continued through the circuit, appellate and supreme court and finally back to the circuit court which issued the writ on Nov. 21, 1921. Mr. McArdle, as construction engineer, has recently completed the building of the road system in Vermilion Co., Illinois, under a $2,000,000 bond issue and returns in person to his former position with the City of Chicago.

Committee To Study Creosoted Bridge Floor Construction

Under the auspices of the American Wood Preservers' Association a joint committee has been formed, including representation of the wood preserving, lumber, fire protection and bridge engineering interests, to study creosoted-wood bridge floor construction. A recent bridge floor fire furnished the impetus for the formation of the committee, on the basis of the probability that improper design of the floor played a part in the spread of the fire. Recognizing that wood must continue in use for a long time as a material for bridge floors, and that, as a measure of safety and conservation, treated wood should be used to protect against decay, the committee will study the question broadly.

The committee will meet under the chairmanship of L. T. Ericson, of the Jennison-Wright Co., who has been appointed representative of the American Wood Preservers' Association. George W. Booth, chief engineer of the National Board of Fire Underwriters, will represent fire protection; E. F. Kelley, of the Bureau of Public Roads, bridge engineering; and D. F. Holtman, of the National Lumber Association, the interests of wood.

W. C. K. Alumni Association

One hundred and forty former employees of Westinghouse, Church, Kerr & Co. met for supper on Wednesday, Nov. 30, and organized the "W. C. K. Alumni Association."

Atlanta Invites Bids for Filters and Clear Water Reservoir

Bids for a 21,000,000-gal. mechanical filter plant, a 10,000,000-gal. covered clear water reservoir and a wash water tank, all of reinforced concrete, together with a piping system of like material and of cast iron are to be received by J. N. Landers, purchasing agent of Atlanta, Ga., on Jan. 31. P. H. Norcross, of Atlanta, is consulting engineer for the work.

Lake Cushman Hydro-Electric Project Still in Doubt

In the superior court of Thurston County at Olympia Wash., the city of Tacoma is fighting another battle to obtain permits to proceed with its proposed development at Lake Cushman, on the north fork of the Skokomish River, of a hydro-electric plant to provide the city of Tacoma with additional electric horsepower. The newest obstacle to the city's project is an action on the part of the State Board of Fisheries, contesting the city's right to divert the waters of the Skokomish River. The city has completed its condemnation suit in the Mason county superior court, won its order of public necessity, settled damage claims, and paid out $300,000 to acquire the project site. The only detail necessary is the permit of the state hydraulic engineer to divert the waters from the river and to create an impounding reservoir, which has been checked by the move of the Fisheries Board.

The board claims that the development of the project would injure the fisheries industry of the state by destroying the spawning beds for salmon in the river. The city will make a strong fight to show that the Skokomish River has never been largely used by Salmon for spawning and that the loss to the industry would be trifling compared to the benefits accruing from the power development.

"Public Roads" Discontinued

Publication of *Public Roads*, the monthly magazine issued by the U. S. Bureau of Public Roads, has been discontinued. By action of Congress at its last session there was a wholesale discontinuation of bureau and department journals and *Public Roads* was caught in the drag-net. It served as a means of making public the general studies and special investigations of the bureau.

Use Opening of New Reservoir to Educate Public

A new 10,000,000-gal. reinforced-concrete reservoir to augment the storage capacity of the Indianapolis Water Co. was put into service in November and the company took this occasion to educate 272 representative business men, including the governor, mayor and heads of the Indiana Public Service Commission and City Board of Trade, into the mysteries of the water business by a 2½-hour inspection trip and set program of explanation.

C. L. Kirk, vice-president and general manager of the company, set forth the accomplishments of the company since 1913 in laying 103 miles of pipe, installing 1,000 hydrants and increasing the daily pumping capacity by 32 m.g.d. The 1920 average consumption he said was 30 m.g.d. and the maximum during summer sprinkling, 75 m.g.d. Improvements in 1921 cost $550,000. The new reservoir is the last of a series of clear-water reservoirs from which the water is pumped to the mains. It is 564½ ft. long, 258 ft. wide, 10.7 ft. deep, has 15-in. side walls and a 9-in. roof supported by 24-in. circular columns which rest on a groined arch floor, 5 to 23 in. thick, below which is a 4-in. reinforced-concrete slab. Preliminary to increasing the capacity of the present purification plant by the construction of mechanical filters an experimental filter is being constructed.

N. J. Plans Snow Removal from State Highways

System Divided into Sections about 12 Miles Long—Early Attack on Snow Essential

Plans for the removal of snow from the state highway system of New Jersey have been developed by the New Jersey Highway Commission. Chief Engineer Thomas J. Wasser has supplied the following information regarding the program:

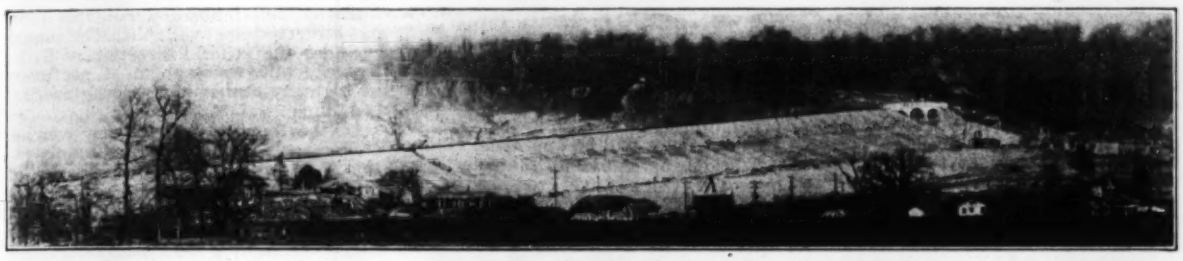
The state highway system of New Jersey comprises 725 miles, including some extensions and connections not yet taken over by the Commission. The system is divided into sections for the purpose of snow removal varying from a minimum of 9 to a maximum of 17 miles, the idea being to have the sections as near 12 miles in length as practicable.

There are 31 sections in what might be called the primary system comprising a total of 402 miles. These sections are assigned to various contractors in the state who have work near these sections or who have their headquarters nearby. Trucks that were received from the United States Government of 2½- and 5-tons capacity are equipped with snow plows and distributed to the various sections before Dec. 1.

Weather Bureau Helps

The Trenton office of the U. S. Weather Bureau co-operates with the State Highway Department and advises as far in advance as possible of the approach of any severe snow storm. This information is immediately telephoned to the contractors in the various sections of the state and they are advised to call together their organization and to go to the garages where their equipment is stationed so as to be in readiness to proceed with the snow removal work as soon as the depth of snow warrants attempting to

Taylorsville Detaining Dam Completed Recently Insures Dayton and Hamilton Against Flood Destruction



The largest of the five detaining dams of the Miami Conservancy District, that at Taylorsville, a few miles above Dayton, controls the main course of the Miami River. Farther north, Loramie Creek, one of the headwater streams, is controlled by the Lockington dam, completed several months ago. Two important tributaries entering at Dayton, Stillwater River and Mad River, are controlled by detaining dams at Englewood and at Huffman respectively, which are nearing completion. Finally, ten miles south of Dayton the inflowing Twin Creek is controlled by a dam at Germantown, which has been completed and in service.

The Taylorsville dam is 3,000 ft. long, has a maximum height of 78 ft., and contains about 1,200,000 cu.-yd. of earth embankment. Its outlet structure, comprising a series of four 15 by 20 ft. arched openings through a concrete spillway weir, is the largest of the concrete structures on any of the district work, containing about 50,000 cu.yd. of concrete. At extreme flood stage the outlet will discharge 50,000 sec.-ft. In a flood as large as that of 1913 the basin back of the Taylorsville dam would impound 152,000 acre-ft. of water.

Construction work at Taylorsville has been in progress three years. O. N. Floyd was in charge for the district as division engineer, assisted by H. L. Fruend, and H. M. Sherwood was construction superintendent. The embankment and concrete work is now completed, but there are odds and ends of work to be done, trimming and the like, which will keep the construction forces on the job probably into next spring.

Incidentally, the historic National Road will cross the valley along the crest of the dam, by way of a 30-ft. roadway. For this purpose the road has been shifted south about a mile, as its old location will be submerged when the dam impounds flood waters.

force it to the side of the road with the scrapers attached to the front of the motor truck, commonly called snow plows.

The success of the undertaking, Mr. Wasser points out, depends on getting out early and keeping ahead of the snow storm. The snow should not be allowed to accumulate to such an extent that it would interfere with the operation of the trucks. The trucks are operated in groups of two and three, the latter number being placed on the sections where the traffic is heavy and where there is likelihood of a heavy snow-fall. It is advisable to have at least three plows in a unit in case one should be out of commission for a time.

The trucks are manned by 3 men: one to operate the vehicle, another to operate the plow; and the third an extra man to be used in the case of emergency.

The remaining mileage of roads in the state highway system, comprising over 300 miles is taken care of by the forces of the state highway maintenance division. A comparatively small mileage in the northern part of the state is not cleared entirely of snow but is kept open for traffic. This is done because many of the vehicles in this section are on runners and there is some objection to removing the snow from the highways on that account. The sections in the southern part of the state are kept clear of snow by the maintenance forces but these roads are not the main through routes in the winter time, nor is the snow-fall as heavy as in the sections first mentioned. The maintenance forces are able to remove the snow with the equipment used for maintenance of roads.

Definite Results of Conference on Unemployment Cited

In his report upon work accomplished and results obtained since the President's Conference on Unemployment was called, Secretary of Commerce Hoover estimates that about 1,500,000 men and women who otherwise would have been unemployed, are now working, through the activities of the conference and local and state associations stimulated by it.

Among the concrete results which Secretary Hoover cites as having come out of the conference are: (1) Public opinion has been focused on unemployment; (2) municipal committees are organized on a nation-wide scale to relieve unemployment; (3) a national clearing house is ready to assist municipalities with district representatives in the field; (4) industry is assuming a share of responsibility to the unemployed; (5) municipal bond sales for public works have broken all records; (6) important public works have been inaugurated by Congress; (7) a large appropriation for the United States Employment Service is before Congress; (8) a variety of measures have been introduced into Congress to carry out recommendations of the conference such as Senator Kenyon's bill for long-range planning of public works; (9) the construction industries are being organized nationally and locally under public direction; (10) stabilization studies are being planned for seasonal and intermittent industries; (11) an investigation of methods for controlling the business cycle is in progress.

To Hold Lumber Congress

The American Lumber Congress will meet in Chicago April 5 and 6. The congress is being sponsored by the National Lumber Manufacturers Association which invites every national, regional and state association to be represented. Three congresses have been held but enthusiasm has waned since the first one was held in 1919. A renewed effort is being put forth with the idea of making the congress occupy the same relative position among forest and wood-using industries as the American Iron & Steel Institute does in the iron and steel trade.

War Department Will Approve San Francisco Bay Crossing

The chief of engineers, U. S. Army, has announced that favorable consideration will be given to a plan for bridging San Francisco Bay provided the plan conforms to certain conditions, has the necessary financial backing and the approval of the cities and counties affected. Five conditions are named, as follows: (1) no bridge of any kind north of Hunters Point will be approved, (2) no low bridge north of San Mateo will be approved, (3) a tunnel crossing the bay in any location will be approved provided the highest part of the structure is at least 50 ft. below mean low water and proper compensation is made for tidal flow, (4) a combined bridge and tunnel at a location south of the proposed Alameda naval base site will be approved provided a 3,000 ft. channel 50 ft. deep is left at the San Francisco end and proper provision is made for tidal flow, (5) not more than one crossing at any location north of San Mateo shall be approved at present.

Seattle's Right to Restaurant Garbage Upheld

The Superior Court recently refused to grant an injunction to prevent the Pacific Meat Packing Co. from carrying out its contract with the City of Seattle, Wash., for handling garbage from restaurants. The law suit on this subject was noted in *Engineering News-Record*, Oct. 13, 1921, p. 627. The contract was made as the result of an ordinance passed by the City Council directing the Board of Public Works to advertise for bids for restaurant garbage. The best bid received was from the Pacific Meat Packing Co, which has a large hog ranch on the east side of Lake Washington. The company is now carrying out its contract, which covers kitchen and table wastes from hotels and restaurants. All other forms of garbage and refuse are collected by the city, as has been the case for years past, and disposed of by the "sanitary-fill method."

According to information from A. H. Dimock, city engineer, the three incinerators built by the city some years ago have not been in use for many years and the "sanitary-fill method" will probably continue to be used as long as available dumping sites within reasonable distance are available. Mr. Dimock adds: "When the cost of haulage becomes excessive, or more than the cost of burning we may return to the method of incineration, but in my judgment it will be many years before that happens."

Contract Awarded on Wichita Falls Irrigation Project

The Callahan Construction Co., of Dallas, Texas, has been awarded a contract for the construction of the Wichita Falls irrigation project, on the Wichita River. The successful bid was $3,354,211. The contract, which is one of the largest let in the vicinity recently, calls for the completion of a diversion dam and a canal within a year, and a storage dam within two years. It is expected that work will be started within thirty days.

McGill Puts Civic Subjects in Engineering Course

A new course for civil engineering students and graduates has been opened this session at McGill College, Montreal, with the object of giving more thorough and detailed instruction in highway and municipal subjects than has hitherto been available. The course is under the general direction of R. L. French, who was appointed professor of highway and municipal engineering last June.

In the fourth year the new courses offered include one in civic administration. It will cover some phases of municipal activity which are seldom touched upon in engineering education, but which should be useful to all city engineers. Among the matters discussed will be the various systems of government, municipal finance, civil service, police and fire departments, recreation, municipal relief of the needy, welfare work and the like.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

The New York Post, Society of American Military Engineers, announces the following meetings to be held in the Engineering Societies Building, New York: Dec. 15, Col. E. E. Winslow, "Flashes of Action at the Front"; followed by a Signal Corps moving picture; March 2, Col. F. E. Humphreys, Commanding Officer, 22nd Engineers, N. Y. N. G., showing a graphical history of the Meuse-Argonne offensive; April 6, Col. George C. Marshall, "History of the A. E. F. and Lessons of the War."

The Lansing (Mich.) Engineers' Club, at its meeting Nov. 16, was ad-

dressed by Col. W. C. Holt, professor on civil engineering, University of Michigan, on the sewerage system of Lansing, present and future.

The **Engineering Institute of Canada, Montreal Branch,** at its opening meeting, presented Roger French with the Gzowski Medal for his paper, "Reinforced Concrete Covered Reservoirs." At the evening session A. E. Doucet presented the first of a series of papers to be given on the Montreal Aqueduct, in which he sketched the whole waterworks scheme of the city.

The Engineers' Association of Fairfield County, Stamford, Conn., recently appointed a committee on city planning consisting of A. S. Brower, G. H. Cavanaugh, H. A. Parsons, V. E. Wardwell and J. W. Mershon, chairman, to draw up a preliminary zoning plan which will be submitted to a citizens' committee on city planning appointed by the mayor.

The Engineering Institute of Canada, Toronto Branch, at its meeting Nov. 3, was addressed by A. G. Dalzell on his experiences in connection with laying 145 miles of sewers in Vancouver.

The Indiana Engineering Society will hold its annual meeting at Purdue University, Lafayette, Ind., Jan. 19 and 20. Among the subjects listed are the following: "The Future of the Gas and Steam Automobile," Prof. A. C. Staly, Purdue University; "Sphere of Influence of the Society," R. C. Yeoman, Indianapolis; "The Engineers' License Law," Prof. R. L. McCormick, Rose Polytechnic Institute; "Current Issues for the Engineer," H. O. Garman, Indianapolis; "Sanitary Engineering," Paul Hansen, Chicago; "The Indianapolis Sewage Plant," C. K. Calvert, assistant engineer, Indianapolis Sanitary District; "The Engineer in Politics," John Elliott, city engineer, Indianapolis. There will be a social meeting Jan. 19 and the annual dinner on Jan. 20.

The Central Ohio Section, Am. Soc. C. E., at a recent meeting, elected as president W. F. Jennings, a member of the Jennings & Lawrence Engineering Co., and as secretary, H. F. Schryver, valuation engineer, Toledo & Ohio Central R.R.

The Northeastern Section, Am. Soc. C. E., recently organized, has elected the following officers: Chairman, Frank B. Sanborn; vice-chairman, Walter C. Voss; secretary-treasurer, Charles W. Banks; members of the executive committee, Leonard C. Wason, James H. Manning.

The New York Section, Am. Soc. C. E., at its Jan. 11 meeting will consider the topic, "Traffic Handling—Its Engineering as well as Regulatory Aspects." The chief addresses will be by E. P. Goodrich, consulting engineer, and Amos Schaeffer, consulting engineer to the Borough President of Manhattan.

The Iowa Engineering Society will hold its twenty-fourth annual meeting in the Woodbury County Court House, Sioux City, Iowa, Jan. 17-20. There will be an exhibit of equipment and material.

A **Sanitary Engineers' Dinner** will be held Jan. 17 at 7.30 p.m. at the Hotel McAlpin. Reservations should be made by Jan. 12, addressing Kenneth Allen, 1235 Municipal Building, New York City.

PERSONAL NOTES

J. R. MCDERMOTT, former assistant division engineer, West Virginia State Road Commission has been appointed resident engineer for the commission in charge of road construction and maintenance in Mineral and Hampshire counties. His headquarters will be at Keyser, W. Va.

VANCE W. BAISE, draftsman and computer with the North Carolina State Highway Commission has been promoted to assistant engineer, department of highway designs and estimates, at Raleigh.

RAY SPEER, county engineer, Keweenan County, Mich., has resigned to accept a position with the Wisconsin State Highway Department, as Madison.

MORSE B. PRINGLE, chief engineer for the Eastman Kodak Co., in charge of the construction of its chemical plant at Kingsport, Tenn., has been appointed city manager of Smyrna. Florida.

G. F. NICHOLSON, chief engineer, Port of Seattle, has been retained by the city of Cork, Ireland, to make a comprehensive plan for harbor development. He has obtained a six months' leave of absence and is now en route to Europe. Before returning to this country he expects to visit the important ports of Europe, particularly those which have extensive mechanical equipment.

E. W. RICE, JR., president of the General Electric Co., has been elected to membership in Tau Beta Pi, the national honorary engineering society.

ALBERT W. SMITH, formerly dean of Sibley College, Cornell University, is now connected with the firm of Henry R. Kent & Co., engineers and constructors, of New York and Boston, as consulting engineer. Dean Smith's work will relate particularly to thermodynamics and mechanical engineering of chemical plants. During the interval between the resignation of President Schurman and the recent inauguration of President Farraud—about a year and a half—Dean Smith was acting president of Cornell.

HOWARD R. FULLERTON, formerly in the sanitary engineering division, U. S. Public Health Service, has been appointed assistant sanitary engineer for the Tennessee State Department of Health on sewage disposal and water supply work.

P. C. MCARDLE, superintending engineer, Vermilion Co., Ill., having completed the $2,000,000 county bond road system, has tendered his resignation effective Dec. 15.

H. O. GARMAN, chief engineer, Indiana Public Service Commission and Railroad Commission for 14 years, has entered private practice in Indianapolis as a consulting engineer. He will handle the management and operation of public utilities. Mr. Garman is president of the American Association of Engineers.

HOWARD C. PHILLIPS, whose resignation as chairman, Western group, engineering committee, Railway Presidents Conference Committee on Valuation, was noted in *Engineering News-Record* of Dec. 8. has taken up consulting work in railway valuation and inspection, with office at 14 East Jackson Boulevard, Chicago. He retains his connection with the engineering committee, having been made associate engineer.

GEORGE W. HAND, assistant to the president Chicago & Northwestern Ry., is chairman of the engineering committee of the Western group, Railway Presidents Conference Committee on Valuation. Mr. John R. Leighty is engineer for this group, instead of being chairman as noted Dec. 8.

OBITUARY

GUSTAVUS O. NEWMAN, chief engineer for the San Joaquin Light and Power Company and the Midland Counties Public Service Corp., of California, died in Los Angeles, Cal., Dec. 4. He was born in Fortuna, Sweden, in December, 1844, and following his technical education, became an engineer of the Swedish government railroad. He came to America in 1868, and his first work was on the construction of a bridge at Kansas City. He entered the service of the U. S. Geological Survey in 1881, and later was connected with the Southern Pacific and Central Pacific railways. For 12 years following 1884 he was chief engineer of the Riverside (Cal.), Water Company. In 1897 he went with the San Gabriel Electric Co. as chief engineer, and when the company was purchased by the Pacific Electric Light & Power Co. he was retained in the same capacity.

BUSINESS NOTES

THE OSGOOD CO., Marion, Ohio, has recently opened a branch sales office in the Conway Building, Chicago, in charge of Arthur B. Sonneborn.

C. E. SLAWSON, contracting engineer, has assumed charge of the Milwaukee district of the Federal Bridge & Structural Co., succeeding L. F. Vonier.

COL. HENRY P. BOPE, for many years first vice-president and general manager of the Carnegie Steel Co., with headquarters at Pittsburgh, Pa., has been elected president and general manager of sales of the International Steel Tube Co., Cleveland, Ohio.

THE GOLDEN-ANDERSON VALVE SPECIALTY CO., Pittsburgh, Pa., announces that it has appointed Lawrence C. Whitsit and F. W. DuBois as its Michigan representatives, to operate under the name of the Waterworks Equipment Co., in Detroit.

E. W. PITTMAN, president of the Pittman-Smith Engineering Co., has been made general manager of the Penn Bridge Co.

B. L. WHITNEY, formerly with the Byers Co., is now representative for Orton & Steinbrenner Co., manufacturers of material-handling machinery, with headquarters at Detroit.

THE PHOENIX IRON WORKS CO., Meadville, Pa., has opened an office in Dallas, Tex., with K. B. Thorndike, as manager.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Bids Wanted on Big Jobs

Among the projects on which are being either asked or will soon be called for in Construction News, pp. 279@287, are the following:

Railway system for Sugar Pine Lumber Co., San Francisco, Cal., $2,500,000.

Terminal Substructure for China Basin Terminal, San Francisco, Cal., $800,000.

Apartment project for Chester Gardens Co., at Cleveland, Ohio, $2,500,000.

Bank and office for Bank of America, New York, $2,500,000.

Theatre and office for Fox Film Corp., Philadelphia, Pa., $1,000,000.

Asylum for Secaucus, N. J., $700,000.

Hotel for Bellerive Investment Co., Kansas City, Mo., $1,000,000.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 279@287 are the following large projects: An 18-story office building in Dallas, Tex., to G. W. Hewitt, Slaughton Bldg., $1,000,000; a 2-story hospital in Milwaukee, Wis., to H. Schmitt & Son, 43 Farwell Ave., Milwaukee, $1,094,000; a 12-story apartment hotel in Cleveland, O., to J. Gill & Sons, Cleveland, $1,500,000; a sewage disposal plant at Columbia, Mo., to C. J. McCoy Construction Co., Emporia, Kan., $178,857.

Hearings on Freight Cases on Building Materials Set

Hearings on the freight rate cases involving shipment of sand and gravel, brick, lime, cement, gypsum and asphalt have been set for Jan. 24 and 25 by the Interstate Commerce Commission. On Jan. 26 and 27 hearings on the lumber and forest products cases will be heard.

Durable Highways Built in Pennsylvania in 1921

Durable highways in Pennsylvania for 1921 exceeded 650 mi. on Nov. 18. According to the State Highway Department this is 300 mi. better than any mark reached by other state highway departments for this type of pavement in one year. The departments maintenance forces put down 215 mi. of waterbound macadam and 297 mi. of unbound macadam and have surface-treated with oils and bituminous materials 1,797 mi. of roadway.

NEXT WEEK

1. Explanation of E. N.-R. Construction Cost and Construction Volume Index Numbers.

2. E. N.-R. tabulation of spring prices since 1913.

3. Price trends of construction materials shown graphically for nine to twenty-two years.

4. Trend of labor—Actual rates on six classes of skilled labor in twenty-one cities for January of 1921 and 1922; chart of common labor and cost of living for nine years.

5. Representative unit bids in 1921.

6. Review of the bond market.

7. Analysis of contracts let.

Majority of Jobs in Chicago Under Landis Award

Reporting on the activities of the week of the Chicago Citizens' Committee to enforce the Landis Award *Chicago Commerce*, published by the Chicago Association of Commerce which is backing the committee states:

"The seven automobiles belonging to the committee have been used in making a check of 800 jobs. Of these 153 are being operated exclusively with men furnished by the citizens' committee. The Landis award was being obeyed on 545 others and a total of only 102 violators was discovered. The first day's investigation was confined to Evanston and the towns north of it. In this locality 63 jobs were visited and 19 violations discovered. Of the violators seven promised the committee that they would reform and abide by the Landis award of $1 an hour for carpenters. During the second day of this work the city was divided into four sections, extending north from Madison St. One car made a further check of Wilmette, Winnetka and as far north as Glencoe. During the second day 128 construction jobs were visited and only 20 violators found."

The committee proposed to be as drastic with contractors who cut below the Landis scale as with those who pay the higher wage demands of the unions.

Paving Prices—Materials and Recent Contracts

With the buying season on road materials over for 1921 and not yet open for 1922, this is a good time to consider how prices have been moving in the last few years and what is their present trend. Road oils and asphalt were most sensitive to the cessation of war orders and the necessity of stimulating the normal peace demand. This is easily shown by averaging the per gallon prices of the five oils listed monthly by *Engineering News-Record*, as follows: 1920 peak, 14c.; December, 1920, 13c.; November, 1921, 5.6c.; today, 6.3c. The same general trend holds for asphalt, which has dropped from $45 per ton at the peak to $15 a month ago and $17 today, in bulk, f.o.b. Bayonne, N. J.

Examination of Table I will give a working knowledge of paving prices. As an index, adding the prices of a square yard of common granite blocks, Chicago, a square yard of wood-blocks, New York, a cubic yard of crushed stone, New York, and a barrel of cement, Chicago, the result is $8.94 for December 1, as against $11.64 at the peak and $11.59 one year ago, the decline being 23 per cent. Quotations prior to 1920 are listed in the last column.

See Table II for contract prices.

TABLE I. PRICES OF ROAD AND PAVING MATERIALS

Material	Current	One Month Ago	One Year Ago	1920 Peak		Previous to 1920
Road Oils						
Price per gal., f.o.b., N. Y. (at terminal) in tank cars, 8,000 gal. minimum:						
45% asphalt	$0.055	$0.05	$0.13	$0.14	(Sept.)	$0.065 (July, 1917)
65% asphalt	.05	.05	.12	.14	(Sept.)	.07 (July, 1917)
Binder	.08	.06	.13	.14	(July)	.085 (July 1917)
Flux	.065	.055	.13	.15	(July)	.0475(Nov.1919)
Liquid asphalt	.065	.065	.13	.14	(Sept.)	.06 (Nov., 1919)
Asphalt						
Price per ton f.o.b. Bayonne, N. J., in 350 lb. barrels or 425 lb. drums	$26.00	$24.00	$36.50	$50.00	(June)	$15.00 (Nov., 1915)
In bulk (carload lots)	17.00	15.00	29.00	45.00	(June)	20.00 (Nov., 1917)
Paving Stone						
About 4x8x4, f.o.b. Chicago, per sq.yd.:						
Dressed	$3.35	$3.35	$3.40	$3.40	(Sept.)	$2.15 (Sept., 1916)
Common	3.00	3.00	3.05	3.05	(Sept.)	1.65 (Sept., 1916)
Curbing:						
Bluestone 5x16 in., N. Y., per lin. ft	.77	.77	.70	.70	(July)	.40 (Nov., 1915)
Wood Block Paving:						
Size 3½, 16 treatment, N. Y., per sq.yd.	2.17	2.17	4.02	4.07	(Sept.)	2.00 (Nov., 1917)
Crushed Stone						
¾ in., carload lots, f.o.b. N. Y., per cu.yd.	$1.80@ $1.90	$1.80@ $1.90	2.15	2.15	(May)	$0.90@ 1.00 (Nov.,1913)
Cement:						
Chicago consumers' net prices, without bags	1.97	1.97	2.37	2.37	(Sept.)	1.19 (all 1913)

TABLE II. PRICES OF SOME RECENT CONTRACTS AWARDED ON STREET AND ROAD WORK

Materials and Unit Prices	Amount	Location	Date	By Whom Awarded	To Whom Awarded
32,042 sq.yd. sheet asphalt at $1.389 per sq. yd.	$44,538	Gloucester Co., N. J.	Oct. 20, 1921	State Hy. Comn., Trenton, N. J.	Union Paving Co., Phila., Pa.
32,220 sq.yd. two-course rein.-con. at $3.566 per sq.yd.	114,900	Clarksville, Tex.	Aug. 25, 1921	Red River Co.	McGuire & Cavender, Leavenworth, Kan.
31,300 sq.yd. concrete at $4.79 per sq.yd.	150,000	Hot Springs, S.D.	Aug. 25, 1921	Municipality of Hot Springs	Allied Contractors, Inc., Omaha, Neb.
Bituminous Macadam 7,400 ft. by 18 ft., 14,800 sq.yds. at $2.615 per sq.yd.	38,704	Agawam, Mass.	Oct. 31, 1921	Dept. Pub. Wks., Div. Highways, Boston, Mass.	Hassam Paving Co., Worcester, Mass.
Grading, draining, curbing and paving 70,000 sq.yd. at $4 per sq.yd.	280,000	Durham, N.C.	Aug. 18, 1921	City of Durham,	Murray Constr. Co., Knoxville, Tenn.

Trend of Business

Money—Call loan rates 4½@5 per cent, time money 5½.

Foreign Exchange—Canadian Exchange 94.3 cents, which is highest in two years. Sterling about $4.20. Generally rising exchanges are aiding sales of foreign bonds.

Railway earnings of Class 1 American railways for 1921 will approximate $561,665,000, net, according to the Bureau of Railway News and Statistics. This is about 3 per cent on the $18,900,000 valuation of the Interstate Commerce Commission. The 1920 net operating income was minus $22,338,836.

Steel employees are offered stock in the U. S. Steel Corporation at $84 for common, to a total amount of 100,000 shares. In other years the offerings were made at the following prices: 1909, $50; 1911, $70; 1912, $65; 1913, $66; 1914, $57; 1915, $85; 1917, $107; 1918, $92; 1919, $92; 1920, $106; 1921, $81.

Textiles — Seasonal dullness in woolen and worsted trades, but William Wood of the American Woolen Co. promises no wage reductions by his company. Demand for cotton goods better, with prices unchanged. Raw silk up to 30 cents a pound owing to advancing market in Japan. Lower prices expected for raw furs. Careful buying of jewelry during holiday season. Little activity in the leather trade. In general, 1922 is expected to be a better year than the one passing; money is easier and many of the large surplus stocks have been sold.

Foreign Construction Projects

Shanghai, China, is planning a sewerage system according to United States Commerce Reports, at an estimated cost equivalent to about $3,000,000 gold, including value of land for a disposal-plant.

A loan of £200,000 has just been floated in London to complete a drainage and sewerage system for Rosario, Argentina. The original estimated cost of this work was £266,000, but £284,720 have already been spent on the uncompleted contract of November, 1910, which was delayed by the war.

Tokyo, Japan, is to install a complete sewerage system at a cost of 20,000,000 yen. Kobe is also to install a system at a cost of 40,000,000 yen. It is possible that some of the pipe used may be of American wood. Tokyo is spending 39,500,000 yen on street repairing and paving in which creosoted wooden paving blocks play an important part. At present these blocks are made in Japan of American fir, but some doubt is expressed as to the efficiency of the Japanese creosoting methods, and there is a possibility that later the blocks may be imported from America.

Large increases in exportations of American lumber to Japan are reported as being due to increased demands in the Japanese market, the cheap price of American lumber as compared with that of Japanese lumber, cheap ocean freight rates and plenty of cargo space, and to the fact that accessible Japanese timber is becoming increasingly scarce. The immediate outlook for American lumber is good provided prices do not greatly increase.

Determining Wages of Building Trade Mechanics

Carpenter's Wage Taken as a Basis—Fair Rates Can Be Computed For Any City

By Thomas H. Coe
Of O. D. Purington & Company, General Contractors, Providence, R. I.

Computation of what fair building trade wages should be was made by the writer in connection with a recent study undertaken for the Master Builders' Association of Rhode Island. In the computation the wages of the carpenter are taken as the basic wage in the so called skilled trades and the wages of the laborer as the basic wage in the unskilled and helpers trades and the differentials between the wages of the trades remained about the same during the period covered. During the first years the relation remained almost exactly the same. Later on it varied slightly, and during the skyrocketing of wages the trades making the most exorbitant demands made some gains over the trades that were more modest.

In the table of wages of skilled mechanics (Table I) the column headed "1913 plus 0.47.1" was computed by giving each trade the same advance over wages in 1913, or the last full normal construction year. The amount is the average of the increases in 1920 over 1913 of all the trades. This column then shows what the May, 1920, rates would have been if all trades had received the same increase in wages over 1913 rates.

We have assumed that the 1921 basic wages should have been 1.6 times the 1913 basic wage. Therefore, the average wage through the country for the carpenter should have been 1.6 × 53 cents, or 84.8 cents per hour, an increase of 31.8 cents. The average for the country for the other trades is then found by adding to the 1913 wages the sum of 31.8 cents and the result is shown in the column headed "Computed 1921."

By tabulating all the 1913 wages for any city and making a comparison with the 1913 average for the country a fair 1913 carpenter's basic wage may be found for that particular city, and the 1921 carpenters wage computed by applying the 1.6. The 1921 wages for the other skilled trades would then be found by adding the same increase in cents per hour to the 1913 country average wages.

The table of unskilled labor and helper's wages is computed in the same manner as the table of the so-called skilled trade wages with the laborer's wage as the basic wage. Computation for any city for unskilled labor rates would be made in the same manner as in the case of skilled labor.

It would seem that for some time statistics are to be the governing factor in the determination of wage scales. If we are working back toward 1913 conditions it is not going to be easy to argue that if we were to arrive at that point the different trades should have the same differentials in pay that they did in 1913.

TABLE I. PAST AND COMPUTED WAGES OF SKILLED MECHANICS IN THE BUILDING TRADES

U. S. Average May Rates per Hour

	1913	1914	1915	1916	1917	1918	1919	1920	1913 Plus 0.471	Computed 1921
Bricklayers	0.686	0.699	0.706	0.713	0.734	0.789	0.878	1.200	1.157	1.004
Carpenters	0.530	0.541	0.546	0.562	0.610	0.668	0.774	1.034	1.001	0.848
Cement finishers	0.552	0.557	0.563	0.568	0.602	0.662	0.745	1.010	1.023	0.870
Engineers	0.586	0.592	0.598	0.604	0.633	0.727	0.797	1.032	1.057	0.904
Granite cutters	0.513	0.518	0.518	0.539	0.559	0.667	0.790	0.970	0.984	0.831
Electricians	0.547	0.564	0.575	0.586	0.624	0.695	0.799	1.051	1.018	0.865
Fixture hangers	0.491	0.521	0.521	0.540	0.580	0.634	0.707	0.953	0.962	0.809
Lathers	0.485	0.494	0.499	0.514	0.533	0.577	0.640	0.916	0.956	0.803
Marble setters, helpers	0.665	0.672	0.678	0.678	0.685	0.718	0.798	1.051	1.136	0.983
Painters	0.505	0.520	0.526	0.571	0.591	0.652	0.763	1.041	0.976	0.823
Plasterers	0.674	0.680	0.680	0.707	0.728	0.761	0.883	1.152	1.145	0.992
Plumbers	0.619	0.625	0.631	0.637	0.662	0.724	0.823	1.064	1.090	0.937
Sheet metal workers	0.512	0.532	0.538	0.548	0.573	0.671	0.737	0.988	0.983	0.830
Steam fitters	0.598	0.610	0.622	0.634	0.658	0.723	0.807	1.070	1.069	0.916
Stone cutters	0.570	0.593	0.598	0.604	0.633	0.673	0.798	1.043	1.041	0.888
Stone masons	0.610	0.628	0.634	0.646	0.671	0.731	0.823	1.146	1.081	0.928
Steel erectors	0.617	0.629	0.629	0.641	0.678	0.777	0.882	1.104	1.088	0.935
Tile layers	0.652	0.658	0.658	0.671	0.704	0.723	0.788	1.062	1.123	0.970
Average rate	0.578	0.591	0.596	0.609	0.637	0.698	0.791	1.049	1.049	0.896
Average increase (over 1913)	.....	0.013	0.018	0.031	0.059	0.120	0.213	0.471	0.471	0.318

TABLE II. PAST AND COMPUTED WAGES OF LABORERS, TENDERS AND HELPERS IN THE BUILDING TRADES

U. S. Average May Rates per Hour

	1913	1914	1915	1916	1917	1918	1919	1920	1913 Plus 0.440	Computed 1921
Building laborers	0.309	0.312	0.312	0.327	0.361	0.423	0.482	0.698	0.749	0.494
Hod carriers	0.356	0.359	0.363	0.373	0.416	0.487	0.569	0.825	0.796	0.541
Marble setters' helpers	0.404	0.408	0.408	0.408	0.432	0.453	0.517	0.873	0.844	0.589
Plasterer's laborers	0.409	0.417	0.417	0.429	0.458	0.528	0.601	0.871	0.849	0.594
Steam fitter's helpers	0.312	0.319	0.328	0.331	0.353	0.409	0.490	0.709	0.752	0.497
Tile layer's helpers	0.359	0.362	0.373	0.387	0.398	0.409	0.498	0.814	0.799	0.544
Average rate	0.358	0.363	0.367	0.376	0.403	0.451	0.526	0.798	0.798	0.543
Average increase over 1913	.....	0.005	0.009	0.018	0.045	0.093	0.168	0.440	0.440	0.185

Engineering News-Record's Cost Index 1915 to Date

Engineering News-Record's Construction Cost Index Number is here tabulated monthly from January, 1915, to December, 1921, inclusive. Next week's issue, Jan. 5, which will feature the Business Side of Construction, will carry the complete monthly list of the Cost Index Number, with chart and an explanation of the Number.

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER
(100 in 1913)

	1915	1916	1917	1918	1919	1920	1921
January	86.12	130.46	167.75	184.51	198.05	206.55	230.87
February	87.36	134.46	167.75	184.51	201.50	225.10	230.67
March	87.66	142.96	175.66	184.51	198.05	240.85	224.27
April	90.16	147.31	183.41	186.01	191.25	265.20	213.07
May	90.16	148.86	187.61	186.01	191.25	268.90	210.82
June	88.96	146.51	199.26	186.31	191.85	273.80	209.82
July	90.51	145.76	204.01	188.65	193.65	265.65	203.82
August	91.76	146.56	198.41	193.85	196.65	252.00	193.07
September	93.01	149.56	190.31	193.85	202.85	255.20	188.27
October	96.16	152.91	167.11	193.85	202.25	255.20	182.57
November	101.06	155.66	166.50	193.55	206.85	255.32	166.32
December	107.06	167.15	167.11	194.75	206.85	251.62	167.82

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 1; the next, on January 5.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$2.78	$4.00	$4.00	$2.88	$3.06	$3.75	$3.45	+$3.85	$4.00
Structural rivets, 100 lb	3.50	5.25	5.50	3.43	4.15	4.25	5.50	4.25	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.68	3.20	3.50	2.68	−2.96	3.57½	3.00	3.75	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	57.65%	45%	57%	61.9–5%	41%	53.7%	−55%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	54.30	44.10	47.80	52.00	50.00	55.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.69	2.55	1.97	2.26	3.10	2.84	3.10	3.12
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.25	2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.80 to 1.90	2.00	3.20	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	38.00	34.00	48.00	+36.00	50.00	30.00	22.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	27.00	21.00
Lime common, lump, per bbl.	−3.00@3.49	1.50	2.75	1.40	1.40	2.95	1.90	3.25	11.00
Common brick, delivered, 1,000	17.40@18.40	9.00	12.72	11.00	17.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0792	.09	.12½	.10	.08@.29
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.72	.78	.88	.74	.80	.90	—.82	.79	.85
Common Labor:									
Common labor, union, hour	.75	.35	.....	.72½	.50	.50@.55	.75	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd. **Chicago** quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Slight advances are reported in two important construction materials during the last week. Seattle quotes structural steel shapes at $3.85 as against $3.75 per 100 lb. and Minneapolis quotes Douglas fir, base sizes, at $36 as compared with $35 per M. ft. one week ago.

Pittsburgh quotes an average reduction of $5 per ton on wire rods, wire and cut nails, making the present price of wire nails $2.50 as against $2.90 and cut nails $2.25 as compared with $2.60 per keg on Dec. 1. Wire rods, are quoted at $38 as against $42 per ton at the mill.

Mill shipments of steel shapes are quoted in Seattle at $3.47; reinforcing bars at $3.37 per 100 lb. An additional discount of 5 per cent is quoted on steel pipe, making the present rate 55 per cent as against 50 per cent. Changes in hollow tile and brick block quotations are expected in the Seattle district after Jan. 1; advances in lumber are anticipated owing to continually increasing demands.

Minneapolis quotes a decrease of 12½c. on reinforcing bars, making the present price $2.96 as against $3.08½ per 100 lb. Common lump lime is quoted in New York at $3@$3.49, f.o.b. cars, as compared with the former quotation of $3.39@$3.69 per lb. (280 lb. net.) Linseed oil is quoted in San Francisco at 82c. as compared with 83c. per gal. last week.

The National Lumber Manufacturers' Association reports production 27 per cent; shipments 33 per cent and orders 36 per cent below normal, for the week ending Dec. 23.

The Southern Pine Association reports 76,534,677 ft. of lumber cut; 67,886,640 ft. shipped and orders for 56,209,284 ft. for the week ending Dec. 17.

The West Coast Lumbermen's Association reports for the same period 62,261,599 ft. cut; 52,020,892 ft. shipped and orders amounting to 60,708,605 ft. b.m.